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ABSTRACT

This book was written in response to a need expressed by Infant's Mistresses in the North Sydney Region of the New South Wales Department of Education. They felt there was a need to evaluate children's progress in mathematics in order to diagnose the causes of individual failures, and they discovered there was no readily available information on either what or how to test. A committee was appointed to investigate and rectify the situation. Goals selected were a massive list of learning objectives, and approximately five test items per objective were constructed. This document consists of instructions and information on testing, selected notes and comments, the tests, an appendix on trialling, and sample student response sheet forms, the product of several years of work. The tests are devised for administering to individual elementary school pupils in grades K-4 with the object of observing the responses of those pupils. The tests are set out in continuous form without age or grade labels, and are organized within three broad categories of number, shape, and measurement. (MP)

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* * * * *

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* * * * *

INTRODUCTION

This book was written in response to a need expressed by Infants' Mistresses in the North Sydney Region of the N.S.W. Department of Education. They felt that there was a need to evaluate children's progress in Mathematics in order to diagnose the causes of individual failures. There was, they discovered, no readily available information as to *what to test* and *how to test* for this purpose.

They therefore appointed a Committee to investigate the situation and if possible rectify it.

This Committee was set up in October, 1974. Its members were Mrs. E. Callan, Mrs. M. Muir, Miss K. Yabsley, Miss J. Watts and Mrs. J. Hodge.

Its terms of reference at that time were:

> "To detail mathematical goals, so that those skilled in the techniques of measurement can formulate evaluation procedures. It is anticipated that teachers will then be able to identify the levels of understanding reached by individual children."

This was consequent on an address to the North Sydney Region Infants' Mistresses' Council (N.S.R.I.M.C.), by Dr. Bob Phillips, who spoke of the necessity for, and the difficulties of, effective evaluation in the teaching of mathematics topics. Those present were mainly interested in the understandings, skills and knowledge set out in the N.S.W. mathematics syllabus for infants' grades. A workshop-type follow-up plainly demonstrated to all present the impossibility of carrying out any effective assessment without first formulating specific goals. Dr. Phillips indicated that when practising teachers had compiled these goals, those "skilled in measurement" could set about composing the necessary test items.

In any learning sequence there is a progression of many small steps, each of which no doubt could be expressed in terms of an objective. The Committee looked at numerous such sequences of learning-steps; it was felt that often the objectives in these sequences merely outlined teaching strategies, or referred to intermediate stages, or described discovery techniques; generally they marked very small advances in skills. Most did not constitute necessary foundations for the next learning stage. The Committee was faced with the task of selecting, from these detailed lists, a series of major objectives which would warrant evaluation to identify levels of achievement.

The committee spent almost two years selecting the mathematical goals. These covered Number, Shape and the various strands of Measurement (Length, Area, Money, Mass, Temperature and Volume). The goals were then expressed as Objectives for a child to reach and master. In each strand, these Objectives formed, as far as is possible, a logical sequence. The ones selected constituted the important steps, the "goals" of achievement, in a child's progress. The intermediate steps were omitted in the evaluation programme, though of course they would not be omitted from the teaching programme.

An example of how the selection was made is afforded by the work in Area. A suggested learning sequence was: (a) understands the terms "covering" and "surface", (b) compares the surface of objects by placing one over the other, (c) seriates objects according to their surface area, (d) covers a surface with informal units and counts them, (e) understands and uses the term "area", (f) finds area in terms of informal units, (g) chooses a unit appropriate to the surface to be measured, (h) estimates area in terms of informal units, (i) ..... It was decided that comparing, seriating and estimating were but intermediate learning steps in Area at this level, and did not constitute *goals*, hence they were not included as major Objectives to be evaluated.

When the Committee had completed the compiling of the goals in all the Strands, they looked about for someone "skilled in measurement techniques" to carry out the second part of the task: "to formulate evaluation procedures". Meetings were held with various Departmental Officers and other experts including Mr. Sid Bourke of the A.C.E.R. The outcomes of these meetings were that no one "skilled in measurement" was available, and that those consulted considered that the Committee members themselves should undertake the task, as they were familiar with the goals specified, and with classroom procedures in Infants' schools.

Mr. Bourke stated (October, 1976): "The lists of mathematics goals devised by the Committee are very comprehensive and can be used as a basis for determining the skills and knowledge possessed by children. The task of writing approximately five items for each goal is a very large one indeed, but one which could have considerable benefits for users ..... In my opinion, the members of the Committee are best placed to write the required items. Any other group would have to spend considerable time and energy going over much of the work already completed by the Committee in stating goals before they would be ready to commence developing assessment items ....."

The Committee therefore set about the task. It was indeed, as Mr. Bourke forecast, "complex and demanding". A lot of care and thought have been put into it. This is the result.

The work was complex because there are so many strands, each with numerous important goals. It was demanding because diagnostic procedures had to be described for each separate goal – at least one per goal, usually several for each, to cater for different aspects and different levels. The size of the resultant volume may be dismaying to readers unless they realise that it is large because it is comprehensive, and it is comprehensive so that in it, somewhere, they may find the particular assistance they need.

The tests have been used in selected schools for a twelve-month trial period (See Appendix).

It is hoped that this document will be of value to teachers in their work with children, and that in some small measure it may assist them to improve their planning of learning experiences, and their knowledge of children's learning difficulties. In short it is hoped that it may help teachers to help children.

* * * * *

December, 1978.

INSTRUCTIONS AND INFORMATION

TESTING

Testing in connection with Mathematics Evaluation may be carried out for any one of a variety of purposes.

There are tests which are organized to rank a given set of pupils, in order, from the most competent to the least competent.

There are tests which are designed to ascertain if pupils have reached a prescribed standard of achievement.

There are tests which are standardised to provide a norm for comparison of the achievements of particular classes or of individual pupils.

There are tests which are devised for administering to individual pupils with the object of observing the responses of those pupils.

The tests in this book are of the last-named type and are designed primarily so that teachers may help children.

APPROACH

As explained above, the tests set out in this book are for the purpose of helping teachers to evaluate pupils' work, so that where a child is not succeeding, help may be given through the diagnosis afforded by the tests.

The approach to diagnostic evaluation in this book is through *a series of Objectives* on which the sets of tests are based.

Each Objective is stated in terms of a child's achievement, rather than of a teacher's lesson aim.

The particular Objectives used have been selected because they are important goals in a child's progress to mathematical competency. Some of them relate to understandings, some to skills and some to the assimilation of knowledge. Each of them is considered a necessary foundation for further progress. There are numerous intermediate goals occurring between those given here, but they do not warrant any intensive evaluation since they merely serve to indicate necessary learning steps along the way.

The Objectives are not listed in strictly hierarchical order. The order suggested is reasonably sequential. An absolute order cannot be prescribed because (a) "all children are different", (b) children learn things in different sequences, and (c) children learn things concurrently.

For the purpose of programming lessons, or testing at varying age-levels, or catering for intermediate stages, the Objectives may be broken into sub-objectives.

For example, the Objective "recognises attributes" can if desired be narrowed to "recognises colours", then to "recognises red". The Objective "knows how to write numerals for numbers beyond ten" can be presented in a series ". . . . . from ten to twenty," ". . . . . from twenty to thirty," ". . . . . from thirty to forty" and so on.

The Objective "covers a surface with informal units, discovers the number required and finds the area" may be broken into its three parts to become three sub-objectives catering for three different age-levels – "covers a surface with informal units", "counts the number of informal units covering a surface" and "uses informal units to find the area of a surface".

PURPOSES

The tests may be used by a teacher

- as a means of assessing the understanding of an individual class member, or

*for diagnosing the area of difficulty of a non-achiever, or
*for discovering the level of competence of a new-comer, or
*as a means of self-appraisal of the classroom teaching.

In addition, for the class teacher, the list of Objectives may be helpful in programme-making, and perusal of the test procedures may suggest the kinds of experience which can help to ensure understanding. A reading of all the Objectives may alert the teacher to areas of instruction which have been omitted from the teaching sequence.

The tests however are primarily for purposes of diagnosis. That is, they are designed to help teachers to help children. Children fail for different reasons, and it is difficult to give assistance until the reason for the failure is discovered.

*A child may be failing because of a developmental difficulty.
*He may be a newcomer whose previous level is unknown.
*He may fail because of a lack of teaching in a certain aspect of the work.
*He may have failed because he did not assimilate the teaching that was given.
*He may not be familiar with certain vocabulary.
*He may lack practical experience of the material or the activity in question.

The tests are designed to help teachers identify the area and cause of difficulty, so that a programme of help may be arranged for the particular child.

The aspect of mathematics which causes most concern to the class teacher is of course that of Number. However the other aspects also are of importance, and early experiences can influence later development; early misunderstandings or omissions may have a bearing on later attitudes or difficulties. Hence there are test items prepared for these other strands also, so that evaluation may, if and when necessary, be carried out in any or all the other aspects of mathematics. It is hoped that this will make the book more valuable to teachers, even thought it makes it much lengthier.

The total number of tests and test items is considerable. Series of tests are provided for Objectives in the various strands:
Number (41 Objectives), Shape (6), Length (12), Mass (12), Time (11), Money (8), Area (5), and Volume (11).

For each child tested only a portion of these will be used. No child will need to be given all the tests in all the strands.

It cannot be too highly stressed that in the name of evaluation (be it of child, or class, or school) it is not intended that any child be subjected to the whole barrage of tests outlined here. Only those tests should be given to a child which are necessary to discover his level of attainment, his degree of understanding, or his area of difficulty and, later perhaps, the amount of improvement that has taken place.

The tests are not intended as standardised procedures for comparing children. Nowhere is it suggested that provision be made for recording a child's total marks; such a score would be quite meaningless in relation to a child's ability or for comparison with any other child's ability.

FORMAT

The tests are set out under Strand headings, first the Number strand, (which includes Problem Solving and Graphs), then the Shape strand, and lastly Measurement (Length, Mass, Volume, Area, Time, Money and Temperature).

Sets of tests are described for each Objective in each strand.

They are arranged in a format designed to be read easily so that the teacher may follow the procedures with minimum difficulty.

Each test is set out in three columns. The *first* states the Objectives being evaluated. The *second* lists the materials which will be needed for the pupil's use; some of this material must first be made, most of the items are readily available and merely need to be assembled and organised. The *third* column sets out the test procedure steps in

detail, using an instruction form: "Place . . ." "Say: . . ." "Ask: . . .".

Guidance is given as to the kind of response which will indicate that the child is competent in the situation. Sometimes there is information about a response which will point to an intermediate stage of development. Before assessing the quality of a child's answer the teacher must refer to the Acceptable Response statement given for each test procedure.

One correct response is rarely sufficient to assume that a child has no difficulties. It is necessary to repeat the test several times in slightly varied form to ascertain if the child is consistently successful. Accordingly, provision is made in the instructions for suitable repetitions of the tests in each separate procedure.

It is suggested that, at any one level, at least five and probably ten, repetitions are necessary for adequate assessment. In some of the test outlines, *five* examples of each procedure are set out. In others, only *one* is set out, and the teacher must frame at least four others of a similar type (generally by varying the numbers of objects used, or the types of objects selected), so that there are sufficient responses on which to base a judgement of the child's consistency. There may be times, especially with lengthy procedures, when one good performance may be considered sufficient.

Each part of a test is called, in this series, a "test item". A *test* may consist of five or ten *test items.* A child is not considered to have succeeded in a test unless he has answered correctly an agreed number of *test items.*

On occasions, where five items (instructions or questions) are set out, the teacher may discern variations in the range of difficulty. Because of the teaching procedure involved and the time-span allotted to it, these questions are considered suitable for the level of understanding under review. In cases where the child fails in one aspect of the test (or where the teaching range has been narrowed) the teacher may frame five or more questions based on each aspect covered in the suggested procedures outlined. For example, in Objective 2 of the Number strand, the test provides for questions covering shape, colour, texture, size, usage, and so on, in the same assessment. The teacher may however, if a more detailed assessment is desired, provide a separate test of five or more questions for shape, then a separate test of five or more questions for colour, and so on.

It will be noted that in some cases the procedure outlined is more lengthy than in others. It seems to be a long time before one arrives at the test question. The stage, as it were, has to be set for the test. These preliminary steps are important for the child's understanding of the test, but his responses here are not to be recorded as part of the test. In cases such as this, the beginning of the test proper is usually marked with a double asterisk, thus **. For example, Objective 17 in the Number strand concerns the set with no members. It is not reasonable to present a child with a bare table-top and expect him to recognise this as an example of the empty set. It is necessary to show him a set whose members he recognises, and all of which he sees removed – at this stage the bare surface will have meaning for him.

The pupil is referred to throughout as a male child, and the teacher as female. This is purely for convenience in writing and reading, to avoid cumbersome forms such as "he/she" and "his/her".

MATERIALS

In each of the strands the materials used for testing are largely those found in classrooms; some are easily made by teachers, and a few are available commercially.

For the Number strand, the majority of the tests are set out using objects found in the child's surroundings. These may be environmental objects such as pencils, spoons, toys; or they may be classroom objects such as round counters or plastic beads. The use of such materials is vital because a child's notion of number comes from his knowledge of his environment, and the purpose of learning about number is to give understanding which can be applied to solving

problems that will occur in the course of his interaction with his environment.

A child however must not only discover number facts and understand their significance, he must also organise, remember and apply his knowledge of these number facts. In many classrooms, parallel with the recognition of the environmental basis of mathematical structures, children are taught to codify and tabulate number facts using structured material (because of the economy of time this ensures, and the consistent model the material provides). For this reason it has been thought desirable to include tests to probe the child's understanding of work given using this material, and of its relationship to similar examples with environmental objects. Such tests of course are only intended for children who are learning to use continuous structured material, such as Cuisenaire rods, for finding and using number facts. For other types of structured material such as centicubes or unifix which can be made into rods the procedures as set out may be adapted, or similar tests devised, in order to test the children's knowledge of their material. The intended application of these tests may be stated colloquially:

*Only "rod children" should do the rod tests.
*All children should do the non-rod tests.

This may be stated in another way:

*The non-rod tests are designed for *all* children.
*The rod tests are only to be given to "rod children".
*The rod tests are *additional to* the non-rod tests.

ADMINISTRATION

The tests are designed to be given to one child at a time, ideally in a quiet spot away from the rest of the children. When this is not possible then the tests should be given in group-work sessions, the teacher carrying out the test procedures with one child only, the other children working independently at some other task.

The tests are designed as face-to-face activities in a one-to-one situation as it is felt that only in this way can an adequate diagnosis be made. In addition to assessing correct responses in such a situation, the teacher may be assisted in her evaluation by noting a child's reactions or pace of working. Even written work in the testing of operations is best carried out and observed in a one-to-one situation. When a written test has been completed, interview-type follow-up is often advisable, and can reveal reasons for a child's responses – often a child may give a correct response for an incorrect reason, or perhaps an incorrect response after correct reasoning.

The materials required for each test should be prepared and assembled before the test begins so that there are no time-wasting distractions. The tester should have read the test items and should know the acceptable responses before beginning, so that the test can proceed smoothly. Provision for recording the child's answers should be made, and any papers arranged so that marking can be easily carried out. A relaxed stimulating atmosphere is desirable.

For the tests, the teacher's instructions, directions and questions as given are suitable, but are to be taken as suggestions only. According to circumstances, the teacher may find other words more appropriate or more likely to produce responses from the child. A child is often more responsive with his own teacher's familiar mode of expression; it is necessary however to ensure that the changed language does not alter the nature of the questions, nor provide the child with undue clues.

Since the tests are not intended as standardised procedures for comparing children, and because they are designed to evaluate the progress of an individual child, it is permissible to change the suggested language or extend the suggested questions to probe whether understanding is present in that child. Sometimes an intermediate stage of development may be discerned through such extensions.

Just as the wording may be changed if considered desirable, so the materials used may be altered according to availability.

The suggestions about objects for compiling sets (blocks, beads, toys and so on) are to be taken as suggestions only and other objects may be substituted if more convenient; the framing of teacher's questions will then be changed to match. Frequently also, the *number* of objects suggested is an example only. For instance, for "place two equivalent sets of *eight* members each", the *eight* may be varied as desired. In such circumstances the text is often marked ††.

There may be initial difficulty in ascertaining the starting point for testing a child. A number of alternatives are possible. The teacher may be guided by the present level of the other children in her class; she may start at a point she thinks will confirm a suspected weakness; or she may decide to begin with objectives known to be attained by the child and "work up" to his level of difficulty, perhaps even skipping a test or two if the tentative starting point has proved to be too low. Sometimes it may be desirable to begin at a stage considered to be too easy in order to establish confidence. With a very young or a very backward child she may simply decide to begin at the beginning. However, once a firm starting-point has been established within a strand, it is intended that tests be given consecutively as far as possible, and not in mere random order. The sequence of tests will be continued until repeated failures occur, which will indicate the child's level of achievement or his stage of development or the cause of his difficulty.

Although the tests have been listed as far as possible in a logical sequence, this sequence is not necessarily the learning sequence. For some Objectives several levels of understanding or achievement may be set out. When this occurs the teacher must select the appropriate level at which to test a particular child.

This applies particularly when testing knowledge of appropriate vocabulary in the various strands, and when testing memorization of number facts as outlined in Objective 37.

Similarly *all* the tests for competence in Problem work are outlined in Objectives 38 and 39. It is not intended that testing of this work be delayed until after treatment of Objective 37; problem-work testing is intended to be slotted into appropriate places in the teaching sequence following study of the relevant operations and numbers, at appropriate levels of difficulty.

Further, a teacher may desire to assess the development of the concept of Conservation in a particular child, and may select a series of tests taken from parts of various strands.

Such variations from the printed sequence are not only permissible, but desirable and necessary.

ASSESSMENT

Assessment of a child's performance is made through observation of his reactions during testing, and analysis of his responses to the test questions. A record of the child's answers must be kept so that his level can be assessed, by means of a diagnosis made from his successes and failures.

A separate assessment must be made for each Objective. Successes in different Objectives cannot be compared or added together. In some cases an Objective is tested with only *one* set of Procedures as in Number, Objective 20; in others there are many tests, as in Number, Objective 37, where there are about 100 separate sections. A combined score made up of the results from testing more than one Objective could not have any meaning where such widely differing numbers of questions are asked. Nor can the value of one Objective be compared with that of another by this means.

Each Objective is tested with at least one Procedure, usually several. Each Procedure sets out a number of variations, called test items, to which the child must respond. A teacher should not assume that a child is necessarily competent after *one correct response* and so discontinue the testing for that Objective.

The question of the number of correct responses required for the assumption of competency must be considered. Probably *eight out of ten* could be taken as conclusive – for reasons of time-saving, *four out of five* may frequently be considered adequate.

Sometimes *five out of five* (i.e. none wrong) or *nine out of ten* (i.e. one wrong) may be a better requirement to indicate competence.

Each successful response must be noted, or each unsuccessful one in order to assess competence. Guidance is given under the heading "Acceptable Response" as to the type of answer which may be marked as successful for each item. This should not be assessed until the "Acceptable Response" section has been read by the tester. It should be noted that for some items a number of questions, not merely one, must be answered correctly before the response can be considered acceptable. For example, in Number, Objective 6, the child must maintain equivalence of sets through a number of re-arrangements.

It is desirable that the teacher's assessment be not an "on-the-spot" judgment, but recorded in some permanent form, for continued reference, so that a child's progress can be monitored over a period of time.

Each teacher may devise her own record of a child's answers and may note thereon the Objectives tested, the number of successful responses made, followed by her diagnosis of the child's performance, together with her programme for assistance to the child. It is, however, desirable that such a record of information about a child be available to his later teachers, and in a form which can be interpreted easily by them. Hence, within a school, a record paper with a uniform marking code is desirable, and with a uniform format.

RECORDING RESPONSES

It is necessary as previously stated that a record be made of a child's responses to the test items for assessment of his level of understanding. It is desirable that this record be retained for study, so that a diagnosis can be made and a programme developed to meet the child's continuing needs. Each teacher can if desired design and maintain a record book for use in her own classroom. It will however be more helpful for those administering and interpreting tests if a standardised form of recording is used within a school.

Because of the large number of Objectives and the differing numbers of Procedures given for each, and also the fact that all the Procedures will not be given to each child tested, it will not be practicable to draw up forms on which the Objectives and items are already set down in print. A form with "blank" columns where the Objectives can be "written in" by the teacher will be adequate; the pages can be numbered and stapled together if a child needs more than one sheet to record all the tests necessary for diagnosis of his problem. The type of Response Sheet decided upon should be prepared on a stencil-master and duplicated as required so that there will be uniformity of recording within a school.

There will need to be columns where the following details are noted: the Objectives being evaluated, either written out in full, or abbreviated in some way; the particular Procedure being used; the level at which it is being applied if there are several levels; the exact number of acceptable or unacceptable responses a child makes; lastly a comment as to whether the overall performance for these test items is considered successful. Perhaps also, notes may be required as to the quality of the child's answers, or his attitudes during the testing. On the sheet, too, other particulars will probably need to be recorded, for example, the date, the child's age and class, perhaps after the test the assessment of his stage of development, or the diagnosis of his difficulty. There may be a space for the tester's name; alternatively the school, particularly if large, may require that a teacher sign a record-sheet before handing it on to the next class teacher.

The columns on the sheet may be arranged vertically or horizontally according to preference.

A standardised marking code within a school is also useful. It is desirable that the marking code agreed upon in the school be specified and noted *on each sheet*. Each tester in the school can then use the same code, so that all who subsequently study the child's performance as recorded on the sheet will be able to interpret the marking.

A speedy and unobtrusive method of noting acceptable and unacceptable responses, and

the number of each, will be the main consideration. When testing is incomplete for a particular Objective it may be advisable if the code makes provision for indicating this and the reason for non-completion.

A SUGGESTED FORM FOR A RESPONSE SHEET

A Response Sheet form which was employed during trialling of these tests, and generally found to be adequate, is included in this book for your consideration. The headings and the marking code were found to be quite satisfactory by most of the teachers who used it during the trialling period. Some schools preferred to use a vertical form because it gave space for a greater number of tests. Some preferred a horizontal form as it gave space for fuller comments. Two examples of each are placed *at the back of the book* so that they can be readily located. One of each should remain in the book for permanent reference; the other, marked with perforation lines, may be removed for assistance in drafting a stencil-master, or for reference when reading these notes.

At the top of the page, on the left-hand side, there is a space for details of the child being tested; on the right-hand side the suggested marking code is set out.

The main part of the sheet has columns for identifying the Objective, for recording the requisite number of responses, for indicating success of failure, and for writing any relevant comments if and when these are considered necessary.

The first three columns are for identifying the Objective being tested.

*The *first* column is for the number of the Objective. The name of the Strand may be written first, e.g. Length, Number, Time. Then the number of the particular Objective (19, 20, 21 etc.) will be inserted and will refer to that Strand. Alternatively, initial letters may by used before the numerals (as in L2, V3, A1) to indicate the Strand. Thus N will stand for Number, S for Shape, L for Length, V for Volume, and so on. This method will cause no ambiguity, since the only duplication of initials is for Mass and Money, Time and Temperature. M/s can stand for Mass, M/y can stand for Money, and T can stand for Time, since in Temperature the Objectives are not formally evaluated with test items.

*The *second* column can contain an abbreviated version of the Objective, or the Key-Words of the statement, so that the teacher can recall the particular test without having to refer back to the list of Objectives when she subsequently studies the child's record of responses.

*In the *third* column, the section or subsection, e.g. "(b) ii", will be inserted.

There is provision for recording responses to ten test items; on occasions the teacher will perhaps consider five items to be adequate. Because of the differing numbers of test items and the varying number of acceptable responses which may be considered adequate for success in a particular test (ten, eight, five, four, or one) it is advisable to note success or failure for each test (or successes only or failures only) in the column provided. Any other comments about performance, such as slowness of working, intermediate level reached, distractibility, or influence of fatigue, may be entered in the final column if desired.

There is NO provision for noting the total number of test items a child answers acceptably, or the total number of Objectives attained. Such total scores would give no guidance as to a child's level of understanding and are meaningless for purposes of comparison.

The column for noting the child's answers will be filled in in accordance with the recommended code. This consists mainly of ticks and crosses, but there are other symbols for use on the occasions when these are not adequate or do not give sufficient information.

☑ A tick will indicate that a child answered correctly or adequately.

☒ A cross will indicate that he answered

wrongly, inadequately, or not at all.

A dot will indicate that although further test items could have been presented, the teacher did not present them because she considered that to do so would have been futile. The dot will signify that there is no intention to give the test item, whereas an entirely blank space will mean that testing did not take place, or has not yet taken place.

Sometimes it may be decided to give five items only, and not ten, perhaps because of considerations of time, or because a child is answering with confidence, speed and accuracy over a number of Objectives. In such cases a horizontal line should be drawn across columns 6-10, which will signify that the giving of these items was considered unnecessary.

If boxes are filled in, this will indicate that further test items are not provided, or are not possible.

A brief example of the filling in of part of a Response Sheet is set out on the next page.

FILLING IN A RESPONSE SHEET

CHILD'S RESPONSE SHEET page 1

Marking code:

- ✓ acceptable
- X failed
- • not presented (futile)
- – not presented (unnecessary)
- ▨ further items not possible

Name: John Smith Class: 1J

Date: 26th June, 1977 d.o.b. 14·1·71

Objective No.	Objective Keywords	Procedure No.	Response to test items 1	2	3	4	5	6	7	8	9	10	Success or failure	Comments on performance (if required)
N. 19	Subsets Objects 1-10	i	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	successful	
	1-20		✓	✓	✓	✓	X	✓	X	✓	X	X	failed	not sure of numbers beyond ten
	Rods 1-10	ii	✓	✓	✓	✓	✓	—	—	—	—	—	successful	
	1-20		X	•	•	•	•	•	•	•	•	•	failed	cannot do work with rods beyond ten
20	Zero and nought	i	✓	▨	▨	▨	▨	▨	▨	▨	▨	▨	successful	
		ii	✓	▨	▨	▨	▨	▨	▨	▨	▨	▨	successful	
21	Combines sets	a i	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	successful	
		ii	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	successful	
	Understands addition	b i	✓	✓	✓	X	X	✓	X	X	✓	X	failed	
		ii	✓	✓	X	X	X	X	X	•	•	•	failed	became tired, effort inconsistent. Is confused
22	Order of combining	i												
		ii												R. Jones

Example of suggested Response Sheet partially filled in

INTERPRETATION OF MARKING

It will be noted that John Smith is aged about six and a half and that the test took place about mid-year. John is probably a newcomer and Mrs. Jones has probably tested him because he does not seem to be at quite the same level as the other children in the class, which is beginning work with addition and subtraction and with recording number facts discovered.

After three tests Mrs. Jones is fairly certain of John's standard. He can work with discrete material and with rods using numbers to ten; he is quite confident with this. With environmental objects he has "picked up" a little information about numbers to twenty but appears to have had no formal lessons about them. He is not confident; although he answered six questions adequately, he was not himself sure that the answers were right. Mrs. Jones does not consider that he is successful here. With rods there is no ambiguity of interpretation; he has *no idea* how to proceed; it is obvious he has had no lessons on rod work beyond ten. John knows the numerals for cardinal numbers and has no difficulties with nought or zero. With discrete objects and with rods, John can combine sets but he has very little realisation of this as representing the operation of addition.

Since John does not yet understand the addition operation, it is useless "slotting in" here the problem work about addition, or the use of memorised addition number facts.

Now that Mrs. Jones has ascertained John's level of achievement and understanding she knows the stage at which teaching must continue.

A study of the filling in of the sheet will reveal Mrs. Jones' selection of keywords to remind her of the Objectives tested. She has decided that for these Objectives, ten correct out of ten will be the criterion for success, and for quick reference has noted success or failure in the appropriate column. For competent responses with numbers 1-10 she has however made an exception in the number of test items. John was so quick, correct and confident in his actions and his answers that she deemed that five out of five gave sufficient indication of success. For Rods 1-20, and for understanding of addition, John was unable to proceed; he did not know what to do. Failure was diagnosed without presenting the full number of items; dots were inserted to indicate the futility of continuing with further items. The shading or cross-hatching shown for Objective 20 indicates to any one who subsequently studies John's sheet that John's one answer constitutes success as variations of this question are not possible.

In the Comments column, it will be noted that Mrs. Jones has inserted entries both about John's test performance and about his behaviour and attitudes. She decided that it is not necessary to write comments unless they are about something she wishes to remember about a child at the time of testing.

FOLLOW UP

No suggestions can be offered here for detailed follow-up when difficulties are diagnosed. These will vary according to the age of the child, but it is obvious that teaching or re-teaching, with planned learning experiences, will be necessary, and possibly further time spent at one particular stage before proceeding to the next stage.

* * * * *

NOTES AND COMMENTS

ADVANTAGES OF TESTING

If through testing a teacher can diagnose the cause of children's failures then it will be possible to plan programmes of help. This in itself will probably save further failure and make future teaching easier. These are the obvious advantages of a testing programme.

But there are other advantages, perhaps less obvious but equally valuable.

- Children generally enjoy the experience. The one-to-one contact with the teacher, the feeling of being special, and being the centre of attention, often has the effect of improving the child's attitude to school, to his teacher, and even to the particular topic of testing.

- Sometimes when a child performs well in the individual testing situation, there is a carry-over of success when the child returns to work in the classroom situation. A child who has become discouraged or apathetic, due to repeated classroom failures, may be stimulated to new interest and effort in classwork because of the glow of success which resulted from the individual work with his teacher.

- Often a child who was previously reluctant to talk, to communicate with his teacher, or to enter into discussions with class groups, becomes so enthusiastic about the testing activities that the conversation begun in the testing situation continues thereafter and the communication problem also is overcome.

- In trial testing, teachers working with children from their own classes found that in each case they began to understand the whole child much better, not just his mathematical troubles. As the children spoke about the activities in the tests they related background incidents which had a bearing on the experiences, in a way they were reluctant to do, or unable to do, in the ordinary classroom situation, revealing facets of personality or thought-processes previously unknown or unsuspected by the teacher.

- Other information valuable to the teacher was also revealed. Some children performed much better in the one-to-one situation than they did in the classroom. They got work right that they never could when working in the class situation, but when they returned to the classroom after success in the test experiences they again performed badly. With such a child the problem probably lies not in his mental ability or mathematical comprehension but in his personality – perhaps he is very distractible, or very easily intimidated; perhaps he has so little confidence in himself that he changes his answers to match those of his neighbours. Knowing where the problem lies, the teacher can give special attention to his classroom placement and the influence of other children on him.

- Sometimes the opposite can happen. There were children who performed well in class, but when they were tested in one-to-one situations they gave very poor responses. Here the teacher was alerted to a different problem – that of the child who is expert at hiding his own inability and who imitates or copies the responses of others. The child may not necessarily be cheating, he may behave as he does out of laziness or insecurity rather than dishonesty. But whatever the reason, the teacher will realise that there is a behaviour problem instead of, or as well as, a mathematical problem and will organise her teaching and her class management to deal with this.

- A frequent advantage from testing was that teachers were alerted to the fact that children's failures were often the

result of short-comings in their own programmes. Many times, vital steps in learning sequences had been omitted. Sometimes vocabulary had not been enriched and extended sufficiently. Frequently there was a paucity of practical experience with real objects and concrete materials. The children had not handled pyramids, cones, cubes, blocks, rods, beam-balances, trundle-wheels, tape measures, attribute blocks, water, sand, and the like. They had not measured distances, pushed heavy objects, or seriated sets of counters. Teachers who realised these short-comings were able to rectify the deficiencies by more careful programming, by taking steps to expand the child's vocabulary, and by including many more practical activities.

- Teachers who carried out the trialling of the tests found that they often received unexpected help from the testing procedures. A child would fail in the first few repetitions of the test items. The teacher would realise that she would need to plan remedial activities for the child. However she would continue with the rest of the test items, commenting on the materials, the language or the actions as suggested in the descriptions, and would find that before the test was completed the child was showing by correct responses that he now understood the questions and would be successful with the particular Objective. The actual test procedure became at the same time a teaching procedure. Though the child was not marked as successful at the time, subsequent testing a few days later confirmed this finding. Even when this does not happen, the test procedures at least indicate an initial approach to remedial activities.

- The test response-sheets can provide tangible evidence of a child's stage of development, level of maturity, or degree of understanding. They can provide proof of lack in skills, or in knowledge or in competence. Teachers frequently are heard to assert that they know their classes so well that they can assess these things without any tests. This may indeed often be so. However such intuitive assessments are not always borne out by subsequent probings. But chiefly they are useless when trying to explain to an anxious or ambitious parent, or a busy supervisor, that a child is *not ready* for the next stage, and *will not yet* be able to cope. The tangible evidence of the response sheet may furnish the necessary proof, so that pressures to place in, or promote to, a grade or class where the levels of work are unsuitable or beyond his comprehension may be resisted.

- Since the Procedures are carried out in a one-to-one situation and actually involve the child in practical activities as a participant and not a mere observer, the need for varied and functional equipment becomes apparent. A good quality beam balance that works, numerous durable models of solid shapes, varied measuring tools and the like are necessities for effective testing. And if they are needed for testing, how much more are they needed for teaching and learning! So the testing experiences may alert those in charge as to the kind of equipment they need to purchase or organise for their classes so that the children will have a good foundation of mathematical experience.

- Finally, the tests may enable teachers to find out about children's attitudes. Attitudes are often as important as knowledge. In one-to-one relationships teachers find that they receive a great deal of information about children's attitudes – their attitudes to school, to mathematics, to experiences, to practical work, to values. An awareness of the children's attitudes is of great assistance to a teacher in knowing how to influence, plan and organise for improvement.

THE TIME TAKEN IN TESTING

It will be admitted readily by anyone who is involved with this work that testing is a time-consuming procedure.

Time is needed for all the aspects of testing.

- Children who can benefit from testing must be selected.

* Response sheets must be made ready.

* A place to carry out testing must be prepared and kept available.

* A "slot" or "slots" in the day's time-table must be arranged and adhered to.

* The most time-consuming of all will be the actual testing of the child, even though procedures for only four or five Objectives may need to be given. Furthermore, children selected for testing are frequently shy, uncertain, uncommunicative, hesitant and slow-moving, which further lengthens the time needed.

There are teachers who, foreseeing all this, decide in advance not to use the tests, *because they take too much time.* These people are saying in effect that is is too time-consuming to help a child whose difficulty needs to be diagnosed.

It is a teacher's duty to assist a child who is failing; it is only sensible to find out the cause of the failure first, so that the right kind of help can be given.

Frequently help is given which is no help at all, because of this failure in diagnosis. Consider the case of a backward nine-year-old who is continually failing in his "two-line add-ups". His teacher without thought decides that the child fails because he needs "more practice". So he is given more pages of vertical "two-line add-ups" – which he continues to get wrong. This is no help. It does not save time.

It is necessary first to consider why the child is failing. In which aspect of work in addition does he lack understanding?

It could be that he hasn't memorized *any* number combinations in addition facts; it could be that he hasn't memorized *some* of these combinations. It could be the vertical form that worries him; maybe he doesn't understand the "carrying" process; perhaps he doesn't comprehend the addition process at all; perhaps he can't combine sets and count the new total. Perhaps, even he doesn't understand the notions of "more" and "less".

If it is any one of these things, extra sheets of "practice sums" aren't going to do any good, and the teacher's refusal to diagnose the child's difficulty is in effect a refusal to help the child overcome his difficulty.

The nature of the help needed will vary according to the problem disclosed by the testing. In the long run, such diagnosis will save teaching time and prevent further problems from developing later.

It is hoped that there are not many teachers who will be too short-sighted to spare time to help a child by first ascertaining the cause of his difficulty.

COMMON CAUSES OF FAILURE

Low general ability, and gaps in a child's information due to absences from school or lack of teaching, are of course frequent and obvious causes of failure. But teachers who carried out tests in the trialling stages found that two other very common causes of failure were lack of familiarity with relevant vocabulary and lack of appropriate experience with materials.

These teachers felt that many of the children would have succeeded had they known the words being used about the test materials in certain of the test questions. Most of these words were common words employed in a mathematical context, which showed that the classroom language must have been, in many cases, very narrow, stereotyped and unvaried. "Ordinary" words well within the comprehension of the children were involved (e.g. *combine, separate, surface*) as well as more specialised words (e.g. *pyramid, circular, estimate*); these words would have caused no comprehension difficulties had they been introduced and frequently used as part of the classroom practice, routines and activities.

Trialling teachers felt also that children would have succeeded in many other tests had they had a proper background of appropriate experiences with actual material and concrete objects on which to base their conclusions. Children who were able to sort plane shapes, such as squares, triangles, circles, ..., were quite unable to deal

with spheres, cones, cubes, ... , although solid shapes are not inherently more difficult to work with than plane shapes – in fact they are probably easier. It seems a logical learning sequence to proceed from solids to surfaces, then plane shapes, boundaries, lines (segments), and finally points. It would appear to be sensible to provide lots of wooden, plastic or cardboard models of pyramids, cones, cylinders, prisms and so on for children to play with, talk about, build with, stack up and pack together – some sets of each, similar in size, other sets in varying sizes. In this way children would learn the names and the properties with very little effort, and then their later explorations would be much more meaningful. Clock-faces, balances, metre-sticks and other measuring devices were strange to many children and so they performed badly with them. The cause of failure was not lack of understanding on the part of the children, but lack of experience, both in using the material, and in talking about it with adequate vocabulary.

Most of the trialling teachers felt that children could be introduced to appropriate mathematical vocabulary at a much earlier stage than many of them are at present, and that children would not only cope with it easily but would enjoy and benefit from the activities in which they discussed the materials they were using by means of a wider range of mathematical words.

TESTING BEYOND GRADE LEVEL

These tests are not designed to discover gifted children, nor to extend "able" children.

It is not intended that in normal circumstances a child should be subjected to testing for Objectives relating to topics, skills or understandings which are beyond his grade level. For diagnostic purposes or to ascertain whether teaching has been successful, this is both futile and unnecessary.

In Volume, for example, a kindergarten child might be expected to know about *full* and *empty*, but should not be questiond about the need for a standard unit; similarly he should know what the *surface* of the table is, but should not be expected to find its area accurately by covering it with informal units, although of course he may be given initial experience in the covering of a surface.

It should be noted that the tests necessary for kindergarten children in any strand are very few, as these children are still in the early experiential stages.

The number of tests suitable for Year 1 children will be slightly greater as the teacher seeks to discover if kindergarten concepts have been achieved.

By Year 2 the need for diagnosis will be greater still as the child has had more work presented to him wherein he may have failed, and so the range of possible tests will be wider.

The full number of tests will probably be of most use with Year 3 and Year 4 children who are failing in primary work because for some reason they are not competent in, or conversant with, the work normally treated in Infants' grades. (Hence the inclusion of the phrase "K-2" in the title of this book.)

SUGGESTED GRADE-AGE LEVELS FOR DIAGNOSTIC TESTING

The tests are designed so that teachers can find out whether a child is having mathematical difficulties because of a gap (or several gaps), in his knowledge, or his skills, or his understandings. A gap of this description may have been caused because there was no previous teaching of the subject-matter in question, or because the child did not assimilate or profit by previous teaching if it did take place. As soon as the child's present teacher has identified where these gaps are, she may provide help by giving the missing lessons, and planning for practice and consolidation of their content. Such diagnosis is particularly necessary for eight- and nine-year-old children in primary grades who are failing in work normally learnt in infants' grades. However, the tests are equally useful for infants' children who have failed to learn the work of a previous grade.

For this purpose certain tests are appropriate

for use in the various grades. Suggested Grade-Age Levels are set out below.

Year 4 in these lists will indicate, in general, children aged nine years, in their fifth year at school.

Year 3 will indicate, in general, children aged eight years, in their fourth year at school.

Year 2 will indicate, in general, children aged seven years in their third year at school.

Year 1 will indicate, in general, children aged six years, in their second year at school.

Kindergarten will indicate, in general, children aged five years, in their first year at school.

When a child is tested for work normally given in a previous grade, the teacher can ascertain if it has been assimilated.

When a child is tested for work given in his own grade, the teacher can ascertain the child's present level of achievement, or his present stage of development (i.e. where he "is at").

In the text, the tests are set out in continuous form without age or grade labels, for use with individual children, for the purpose of monitoring their progress through the various stages to a level appropriate for each child.

SUGGESTED LEVELS

Year 4	Year 3	Year 2
Tests suitable for administration, if required. **Number**: All tests. **Other Strands**: All tests.	Tests suitable for administration, if required. **Number**: All tests. **Other Strands**: All tests.	Tests suitable for administration, if required. (The time of the year when the test is given will influence the selection of Objectives and the choice of levels.) **Number**: All tests, by end of year. The more difficult aspects of work with fractions and division may be omitted if desired. **Other Strands**: All tests, by end of year.

SUGGESTED LEVELS (continued)

Year 1	Kindergarten
Tests suitable for administration, if required. (The time of the year when the test is given will influence the selection of Objectives and the choice of levels.) **Number**: Objectives – 1 - 29, 34, 37 (at an appropriate level), 38 - 40 (all at appropriate levels). **Shape**: Objectives – 1 (at an appropriate level of vocabulary), 2, 3 (at an appropriate level), 5 (at an appropriate level), 6 (vocabulary at an appropriate level). **Length**: Objectives – 1, 3, 4, 10 (at an appropriate level), 11 (at an appropriate level), 12 (vocabulary at an appropriate level). **Mass**: Objectives – 1, 2, 3, 4, 5 (two objects only), 6, 10, 11 (at an appropriate level), 12 (vocabulary at an appropriate level). **Volume (Capacity)**: Objectives – 1, 2, 3 (Procedures i and ii), 5, 6 (at an appropriate level), 10 (at an appropriate level), 11 (vocabulary at an appropriate level). **Area**: Objectives – 1, 2 (covering surfaces only, for a few children only), 4 (at an appropriate level), 5 (Procedure 1, for some children).	Tests suitable for administration, if required. (The time of the year when the test is given will influence the selection of Objectives and the choice of levels.) **Number**: Objectives – 1 - 17, 19 (a) i, 20 (i), 21 (a) i. **Shape**: Objectives – 1 (at an appropriate level), 2 (at an appropriate level), 3 (at an appropriate level). **Length**: Objectives – 3 (not waste paper tin), 10 (at an appropriate level), 12 (vocabulary at an appropriate level). **Mass**: Objectives – 1, 2, 10 (at an appropriate level), 12 (vocabulary at an appropriate level). **Volume (Capacity)**: Objectives – 1, 2, 5, 10 (at an appropriate level), 11 (vocabulary at an appropriate level). **Area**: Objectives – 1, 2 (at an appropriate level). **Time**: Objectives – 1, 2 (o'clock only), 3 (week days), 6 (vocabulary at an appropriate level).

SUGGESTED LEVELS (continued)

Year 1 Cont.	Kindergarten Cont.
Time: Objectives – 1, 2 (o'clock and half-past), 3 (at an appropriate level), 6 (at an appropriate level). **Money:** Objectives – 1, 2, 3 (for some children), 4 (for some children), 6. **Temperature:** Objectives – 1 and 2 (both at appropriate levels).	**Money:** Objectives – 1 (not 50 cents), 6 (one dollar note). **Temperature:** Objectives – 1 and 2 (both at appropriate vocabulary levels).

MEMORISATION and PROBLEM WORK AND GRAPHS

Although the Objectives have, in general, been written in a logical and sequential order it is not possible to maintain a strict teaching/learning sequence throughout.

Two particular facets must be regarded separately as to their place in the sequence. These are the testing of memorisation of number facts, and the testing of competence in problem work and graphs.

(a) **Testing memorisation and use of Number facts**

All the memorisation tests are outlined in Objective 37 but it is intended that teachers insert the relevant parts of the test *at appropriate places* in each child's learning sequence. For this reason categories are specified throughout the tests for memorisation so that different levels can be discerned. This is not only to make it possible to pin-point areas of difficulty for an older child. It is also so that teachers can select the proper categories for younger children.

These tests are intentionally detailed and therefore lengthy. It is of course quite possible to design shorter tests composed of fewer examples. But it must be realised that the tests in this book are presented not as tests of knowledge or achievement, but as diagnostic procedures to discover the particular area or level of difficulty in the memorisation or use of number facts.

(b) **Testing competence in problem work and graphs.**

Testing of knowledge of the different aspects of problem work and graphs is treated in Objectives 38, 39 and 40. But it is not intended that testing of these should be delayed until the previous 37 Objectives have been tested. Testing in Objectives 38, 39 and 40 should be slotted into the appropriate places following study of the relevant operations and numbers.

USE OF "CRUTCH" FIGURES

When working with the more complex types of number sentences, such as

$4 + 2 + 2 = \square$ and $9 - 4 - 2 = \square$ many children make use of "crutch" figures (small numerals representing partial answers) written above the relevant part of the sentence. The numeral 6 may be written above $4 + 2$, and the numeral 5 may be written above $9 - 4$, in the examples above.

Number sentences completed correctly using this device may be accepted on an equal basis with those completed correctly without it.

Some teachers may prefer to see use of this device as indicating an intermediate stage, to be accepted, and commented upon as such when recording the child's progress. The child will then be expected to complete similar number sentences at a later stage without use of "crutch" figures, showing that he can mentally retain sub-totals for a longer time than previously.

It should be noted that the use of "crutch" figures by children having difficulty gives the tester increased opportunity for diagnosis, and for these children at least the use of "crutch" figures should not be discouraged.

"NUMBER" BIAS

Concept formation begins in the earliest years. This is so in all the strands of Mathematics which are set out in the curriculum, and not only in the Number strand. Trialling experiences suggest that many of the tests in Area, Shape, Volume, Length, Mass, Money, Time, and/or Temperature could not be given because there had been no teaching of the topics covered in the test items. Sometimes this was because the topics had inadvertently been omitted from the class programme. However, it was found on many occasions that the teacher had consciously decided to omit these other strands as unimportant and to concentrate on number concepts and experience.

This is unfair to children. The early concepts in the other strands are just as important to later development in those strands as early number concepts are to later arithmetic studies.

If a kindergarten child has a good idea of the word "surface" and of the surfaces of things around him, he will later have a better chance of understanding Area than a child who is merely given a formula (e.g. "l x b") at the age of nine or ten.

Early experiences in measuring with a variety of units, in making simple graphs, in playing shops with money, in handling models of cubes, pyramids, cones and other solids, all provide interest as great as in Number, but at the same time are designed to lead to acquisition of necessary concepts, suitable for the child's stage of development, which will facilitate future learning. It is not fair to deprive him of these experiences merely to concentrate on the Number strand.

If these ideal learning-times are missed, subsequent learning is often more difficult.

CONSERVATION

Although an understanding of Conservation is vital to successful work, the concept is developed only after a large number of contributory experiences. For this reason, testing about Conservation is set down near the end of the list of Objectives for the appropriate strand and not first. The development of the concept is slow, and is not uniform throughout all the strands.

For teachers who wish to follow the development of this concept in children the relevant tests are set out below. It is not expected that the concept will be fully developed throughout, at least until the age of seven years. Five- and six-year olds may be given the tests, and their results will show a variety of intermediate stages. No consternation need be felt about this; all that is indicated is the need for further experiences, and an understanding of the child's present stage of development.

Procedures appropriate for ascertaining the stage of development of the Conservation concept in particular strands are set out below:

Number: Objectives 6, 15, 16, 22.

Shape: Objective 2 (ii) may have a bearing on the development of the concept.

Length: Objective 10.

Mass: Objective 10.

Volume (Capacity): Objective 6.

Area: Objective 5.

Money: Objective 2. (The different ways of making up the same amount may have a bearing on the development of the concept.)

GENERAL KNOWLEDGE

Questions regarding applications in the environment (Why are plates round? Why are triangle-shapes used in bridges? Why the diagonal on wooden gates?) are not intended to be questions on General Knowledge. They are designed to ascertain how much the child has understood and retained from class lessons and discussions about these matters, or in the case of a newcomer whether the child has had such teaching and if so, whether he has understood it.

Instead of individual questioning in a test situation the teacher may prefer to base her assessment of the child in a class situation during discussion of these topics, and then on his Response Sheet she will note perhaps the thoughtful relevant nature of his contributions to the discussion and how well they indicate his grasp of the ideas.

Similarly with test items concerning the digital clock, the trundle wheel, the calendar, and the thermometer, the questions are designed to follow class experiences, or to indicate the lack of class experiences. They are *not* designed to probe the home background or discover any general knowledge otherwise acquired (useful though this may be).

PROMPTING

Some of the teachers who carried out preliminary testing were concerned about diagnosis of responses when the wording was altered in statements and questions to children. Those teachers wondered whether the changes they made would constitute "prompting", even though they were informed that it was permissible to make changes in the interests of communication with the child.

The following suggestions are given.

* Where the changes are mere alternative forms in the choice of words or phrases, and are substituted to accord with the teacher's usage familiar to the child, this will have no effect on the assessment of the response.

* Where radical changes must be made because the child has no knowledge of the vocabulary in question, this can affect the result; the tester may be unable to discover if the child really understands and could be successful in a particular Objective. She may feel that he would be capable of success in spite of the necessity to explain the words; if so she should note this on his Response Sheet, but should also note his failure with the correct vocabulary (and in follow-up should include the necessary language work!).

* It is not permissible to make changes which alter the nature of the question or give clues as to the answer required and still mark the child as correct. If such changes are made an intermediate stage of understanding may be discovered, which should be recorded on the child's sheet. After further experiences using adequate vocabulary, the child may succeed fully when retested.

* Whenever an alteration to wording is made which the tester feels may constitute prompting, or have a bearing on the child's response, this should be noted in the Comments column of the Response Sheet.

The frequent occurrence of this problem indicated the "narrow" nature of the vocabulary employed, and the limited use of alternatives, in some classrooms.

Words such as *combine, separate, pattern, subtract, represent, difference, compare, match, remove, pair, equal* and *complete* could be used much more often in context and would broaden the child's experience and communication, as well as making assessment of mathematical understandings more accurate.

WRONG RESPONSES

It is important not to tell a child he is wrong in his answer, and for the tester to receive all responses with equal interest. A child's subsequent responses can be influenced by the tester's reactions to answers. Similarly it is important not to let the child observe the tester's crosses and ticks while responses are recorded. Children sometimes are diverted by trying to work out the code and do not then attend properly to the next question.

It has been noted that one correct response is not, generally, sufficient to assume success. In the same way, the tester must not assume that if the first response is incorrect, failure is to be recorded for the particular Objective. If a child continues to give answers for the test items then probably four wrong responses would justify the decision to record failure, and to discontinue testing. Failure must be recorded earlier than this in cases where a child makes one wrong response and then is unwilling, or refuses, to try further.

Sometimes it is unwise to continue with questions when the child knows all his answers are incorrect; this often discourages or upsets the child, and can influence his attitude to the next set of test items. The tester must rely on commonsense in the case of wrong responses, just as much as in the case of correct responses.

HOW MANY TIMES?

The question of how many times a child has to respond correctly for success must be considered in relation to each Objective.

In the instructions for administering the tests and marking them, it has been suggested that four correct responses out of five can be taken as conclusive in most cases, but that sometimes a score of eight or nine out of ten is more reliable.

This is because the four correct responses may be the limit of the child's knowledge and he could get no more answers right no matter how many further questions were asked. Four out of five would become four out of ten, which could not be counted a successful effort.

Further, a child may answer correctly after a great deal of thought, hesitation and self-correction, and may not appear confident in his approach. The tester may then not be sure whether four such responses were right after much effort, or were purely "lucky" guesses. Eight such correct responses would earn the child the right to be labelled successful, although a note in the Comments column about his performance would be desirable (and perhaps re-testing at a later date to see if he is then more confident in the situation).

Also, many young children frequently waver for a long time between *knowing* and *not knowing*. This can happen in many learning situations, e.g. in writing b and d correctly, in knowing the right and the left hand, in spelling a difficult word. The child may be right to-day, wrong to-morrow, right again the next day. This happens too in mathematical matters, and is another reason for being cautious about accepting a single response as conclusive. When it is felt that a child is at such a stage in the development of a skill or an understanding, it may be advisable to give the test over several days to be sure of the child's consistency.

In the majority of cases the tests are short, and the test questions are simple; it is not much more difficult to give five items than to give one. Similarly it is not much more time-consuming to give ten items than to give five. The child will not become bored or fatigued if the tests are presented in an interesting manner by the tester.

Nevertheless there will be other cases where five or ten test items will not be appropriate.

How many times must a child count to a

hundred to prove that he can count to a hundred? If he counts quickly and confidently, without hesitation, passing from 39 to 40, 59 to 60, and so on, without faltering, then surely he doesn't need to repeat the performance further to convince you – certainly not five times, let alone ten!

Counting to a hundred is not one of the tests in the book, but in cases such as that, where the test is lengthy, and the child perfectly confident and perfectly accurate, there is no need for further repetitions.

Other cases where repeated test items are unnecessary may be suggested. Where the tester is giving preliminary tests to ensure that the child is comfortable in the situation, there is no need to give repeated items. Where preliminary tests are being given to ascertain a suitable starting place there is no need to give more than one or two items.

To persist with numerous repetitions in such circumstances will cause both tester and child to feel extreme boredom and fatigue, not to mention distaste for the whole programme!

Since the tests are not intended to be standardised procedures, the number of repetitions does not have to be uniform. It is left to the tester's experience and commonsense to decide which are the tests where repetitions are necessary, and how many repetitions should be given. Where it is decided not to give a number of test items this will be because of the complicated or lengthy nature of the tests and the child's competence in responding. (But if the child is not confident, and his responses are inconclusive, repetitions will be needed even though the test is lengthy.)

SIZE OF THE BOOK

The thickness of this volume, and the comprehensive nature of the contents, have proved daunting, not to say "off-putting", to many teachers at first sight. They think that it will not be possible to read it all before using it. They think also that they will not be able to administer *all* the tests in it and therefore they will not have a use for it.

Let us say at once you don't have to read all the tests before you can use the book; the introductory pages will explain how the tests are to be given and used.

Let us ALSO say at once that it is not intended that anybody will need to use all the tests. Four or five tests per child in any particular strand will probably be quite sufficient for a diagnosis.

The size of the book is brought about because the Number, Shape and Measurement strands are all included. It was considered at first that three separate books might be issued; teachers when consulted indicated that they nearly all preferred the inclusion of *all* tests in one volume.

The *amount of the content* is brought about because the range of tests must be comprehensive. A child will have difficulty with only a few aspects of his work to date, and usually it will only take five or so tests to ascertain which these aspects are; however they will differ from child to child. Some children will have difficulty with early concepts, some with later skills. Some will have difficulty in memorizing certain facts, some will not understand certain types of environmental situations when expressed in words. Nobody can know in advance which tests are going to be needed, hence all are included here. An all-inclusive volume of this nature is necessarily lengthy. Guidance is given in the Introduction and the Index of Objectives as to how the tests may be used. The comprehensive nature of the book causes its size and thickness but this is intended to be an *advantage* to teachers not a *hindrance;* the range of tests is designed to increase the range of assistance which teachers can give to children who may be having difficulty.

WHY "SETS" AND "SUBSETS"?

If mathematics is going to mean anything to young children it has to be *real.* They should discover it, apply it and understand it in terms of their own environment and the things in that environment. When they have had experience with real things they may supplement their work by using mathematically structured materials, particularly in

order to organise and tabulate number facts. But if they do not understand number facts in terms of the real objects in their environment we cannot be sure that they understand Number at all. Hence in testing mastery of the Number Objectives whenever possible tests have been written using objects which are familiar to the child in his home and his schoolroom.

These tests are described for the teacher's benefit using words such as *set, member, element, combine, partition, separate,* and so on, and sometimes in the questions and requests to children some of these words are also used.

It is pointed out to readers and testers that these words are used in explanation of the tests about environmental objects. They are used with the same sense and meaning as they would have in ordinary conversation. They provide a much more concise and exact form of communication than alternative forms of description, for example, "this collection of things", "some of these things", "another lot of things", "the rest of the things", "this group", "these smaller groups", and so on. Only one of the words used ("subset") is at all specialised and not found in ordinary conversation. If desired, this word can be avoided and substitutions made; most triallers found no difficulty and preferred its brevity to the possible alternative circumlocutions. The emphasis in these tests is not on the words but on the activities they describe and the ideas they convey.

It is stressed that there is no intention of introducing or testing knowledge of Set Theory or the correct use of its vocabulary.

The words are used in an environmental context to provide clear descriptions of activities, widen and enrich vocabulary, relate mathematics to every-day life, and enable children to express ideas concisely.

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THE TESTS

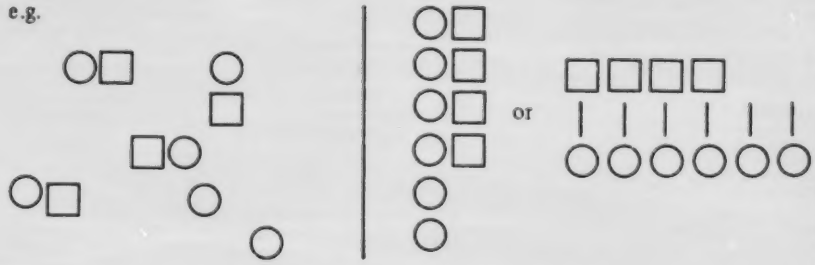
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Identifies attributes** (using the language of attributes)	The child's classroom environment.	**PROCEDURE**: Say: "Show me something blue." "Show me something rough." "Show me something round." "Show me something wooden." "Show me something to write with." "Show me something heavy." Make five or ten such requests to give the required number of test items. The attributes given above are suggestions only. The tester should select those attributes considered the most appropriate for future development. **Acceptable Response**: The child points to indicate the object with the appropriate attribute.
2. **Classifies an object by means of its attribute(s)**	i. About twenty objects different in colour, shape, size, usage, composition and/or texture.	i. **PROCEDURE**: Place all the objects before the child. Say: "Show me a rough block." "Show me a blue bead." "Show me a round thing." "Show me a wooden box." "Show me something to write with." "Show me a heavy toy." "Show me a big red tin."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)		Make five or ten such requests to give the required number of test items. **Acceptable Response**: The child indicates the correct object by speaking or pointing. **Notes**: • Suggested teacher instructions are based on each of the following categories: shape, colour, size, usage, composition, texture, and conjoint attributes (i.e. two together). • If a child experiences difficulty with any of the categories, the teacher should retest with further questions concerning that category.
	ii. About twenty objects different in colour, shape, size, usage, composition and/or texture.	ii. **PROCEDURE**: Show the child five, or ten, of the objects one at a time. For each object, say: "Tell me something about this." **Acceptable Response**: The child makes responses in the form: "It's red." "It's made of plastic." "It's heavy." "It's soft." "You write with it." **Note**: If a child gives a response of the type "It's a pencil" (i.e. name only), continue: "Tell me something else about it."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. **Sorts objects.**	Collections each of about fifteen objects with clearly defined attributes. Collections of objects may be based respectively on the following categories: • colour • shape • colour and shape • environmental usage • ownership	**PROCEDURE**: Place one of the collections of objects before the child. Say: "Sort these things for me." or "Put the things together that belong together." When the child has carried out this direction, say (indicating one group, then another, . . .): "Why did you put these things together?" Repeat, to give the required number of test items, using other collections one at a time. **Acceptable Response**: The child justifies the basis of his sorting. **Note**: These test items cover a range of understanding at the same level. If, however, the child succeeds with only some of the categories, the teacher may design test activities for *each* of the categories, to ascertain the particular category causing difficulty.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. **Makes given sets.**		**PROCEDURE**:
	i. A selection of diverse objects.	i. Place the diverse objects before the child. Say: "Make a set of buttons."
	ii. A selection of toy animals.	ii. Place the toy animals before the child. Say: "Make a set of cows."
	iii. A selection of counters.	iii. Place the counters before the child. Say: "Make a set of blue counters."
	iv. A selection of beads.	iv. Place the beads before the child. Say: "Make a set of big round beads."
	v. A selection of attribute blocks.	v. Place the attribute blocks before the child. Say: "Make a set of small thick square blocks."
	Note: Other suitable categories of objects may be substituted, and the test instructions adjusted accordingly.	Any of the activities may be repeated, using slightly different material, to give the required number of test items.
		Acceptable Response:
		The child performs the appropriate action.
		Note: There is a range of difficulty among the test activities. If a child fails in carrying out any of the test items, the teacher should re-test with at least five activities *each* for i. (general appearance), ii. (particular appearance), iii. (one attribute), iv. (two conjoint attributes), to ascertain the particular aspect causing difficulty.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **(a) Pairs the elements of one set with the elements of another set.** **Note**: The word "member" may be substituted for "element" if desired.	(a) i. Two non-equivalent sets of similar objects (e.g. four buttons and six buttons) ii. Two equivalent sets of similar objects, (e.g. five marbles and five marbles) iii. Two equivalent sets of dissimilar objects (e.g. seven pebbles and seven counters) iv. Two non-equivalent sets of dissimilar objects, (e.g. four pegs and six beads) v. Two non-equivalent sets whose members are *all* dissimilar (e.g. a set of four consisting of a marble, a bead, a block, a counter, and a set of five consisting of a bottle-top, a pencil, a thimble, a toy car, a shell).	(a) **PROCEDURE**: Place the two sets described in (i) before the child. Say: "Pair the elements (things) of these sets." Repeat, using the sets for ii, iii, iv and v; any of the activities may be repeated using different objects, to give the required number of test items. **Acceptable Response**: The child performs the appropriate action. Sometimes all the elements of one set will be paired with all the elements of the other, sometimes there will be elements of one set which cannot be paired with a member of the other set. The pairs may be placed randomly or in an ordered fashion. e.g.  **Note**: If desired, the teacher may test with at least five activities *each* for i, ii, iii, iv and v.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **(b) Finds whether sets match or do not match by using the technique of pairing.** **Note**: When sets match they are said to be equivalent.	(b) As for 5(a) i-v. i. Two non-equivalent sets of similar objects (e.g. four buttons and six buttons) ii. Two equivalent sets of dissimilar objects, (e.g. seven pebbles and seven counters) iii. Two equivalent sets of dissimilar objects, (e.g. seven pebbles and seven counters) iv. Two non-equivalent sets of dissimilar objects, (e.g. four pegs and six beads) v. Two non-equivalent sets whose members are *all* dissimilar (e.g. a set of four consisting of a marble, a bead, a block, a counter, and a set of five consisting of a bottletop, a pencil, a thimble, a toy car, a shell).	(b) **PROCEDURE**: Place the two sets described in (i) before the child. Say: "Find out whether these sets match or do not match." Repeat, using the sets for ii, iii, iv and v; any of the activities may be repeated using different objects, to give the required number of test items. **Acceptable Response**: The child correctly performs the action of pairing the elements of one set with the elements of the other. The pairs may be arranged randomly or in an ordered fashion. If all the elements of one set are paired with elements of the other set, he states that the sets match. If there are unpaired elements in one of the sets, he states that the sets do not match.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. **Understands that two equivalent sets remain equivalent however the elements of each set are re-arranged.**	For each activity, two equivalent sets of related objects. For example: i. knives, forks ii. cups, saucers iii. triangles, strikers iv. flowers, vases v. books, pencils **Note**: As a final test, if desired, the procedure may be repeated using equivalent sets of *unrelated* objects, e.g. marbles, crayons.	**PROCEDURE**: i. Place two equivalent sets of related objects before the child. Match the sets and then ask (for example): "Is there a knife for every fork?" Move the knives a little apart, and repeat the question. Restore the sets, then move the forks closer together and repeat the question. Restore the sets, then move the knives widely apart and the forks a little apart; repeat the question. ii. iii, iv, v. Repeat the procedure for all the examples, varying the order of re-arrangement. Any of the activities may be repeated, using other sets of related objects, to give the required number of test items. **Acceptable Response**: The child succeeds if he maintains that there is equivalence of sets through all arrangements. **Note**: The more widely the objects in the sets are spaced, the more likely it is that the child cannot maintain equivalence of sets. Therefore these experiences need to be repeated constantly until understanding is established. (The concept is conservation.)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. **Counts the members of a set.**	Sets of objects, in number within the range 1 - 10. Later, within the range 1 - 20.	**PROCEDURE:** Place a set of objects before the child. Say: "Count the members, in any order." or "Count these things (beads, cars, . . .) for me." Repeat, to give the required number of test items, using other sets, the members varying in number; some sets to have similar, and some to have dissimilar members. **Acceptable Response:** The child succeeds if the counting sequence is correct, and no member is missed or counted twice. The tester should record *how far* the child can consistently maintain one-to-one correspondence while counting (e.g. *to ten*). **Note**: The child is not required to state the cardinal number of the set.
8. **Finds the cardinal number of a set.**	Sets of objects, in number within the range 1 - 10.	**PROCEDURE:** Place a set of objects before the child. Say: "Count the members (things, cars, . . .). How may in the set?" Repeat, to give the required number of test items, using other sets, the members varying in number; some sets to have similar, and some to have dissimilar members. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
8. (continued)		**Acceptable Response:** The child succeeds if he counts correctly, and states, (for example): "Seven" or "Seven things" or "There are seven members (things, cars, . . .) in the set." **Note:** The child may count silently or aloud. If the child counts silently and gives an incorrect answer, ask him to count aloud.
9. **Makes a set containing a given number of elements.**	A collection of objects.	**PROCEDURE:** Place a collection of objects before the child. Say: "Make a set of six." Ask: "How many 'things' in that set?" Say: "Show me one object." Ask: "How may 'ones' in that set?" Repeat to give the required number of test items, on each occasion asking for a set containing a different number of members, and questioning the child as to the number of elements ("ones") in the set. **Acceptable Response:** The child makes the set correctly and indicates by his response that he understands, for example, that a set of six consists of six elements (six "ones").

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. **Matches numeral with cardinal number.**	i. A set of numeral cards in the range 1 - 5 5 - 10 1 - 10 and, later, 1 - 20 Sets of objects with similar or dissimilar members within the range 1 - 5 5 - 10 1 - 10 and, later, 1 - 20	i. **PROCEDURE**: Place a set of objects before the child, and give him the appropriate set of numeral cards. Say: "Count this set and find the right (numeral) card." Repeat, to give the required number of test items, using other sets within the selected range. **Acceptable Response**: The child selects the appropriate numeral card. **Note**: For an older child begin with the range 1 - 20. If the child finds difficulty at the later levels, give five tests at *each* of the earlier levels indicated.
	ii. A set of numeral cards as for (i) and a rubber ball.	ii. **PROCEDURE**: Bounce the ball a number of times, within the numeral card range, and ask the child to find the appropriate card. Repeat to give the required number of test items, making a different number of bounces on each occasion. **Acceptable Response**: The child selects the numeral card which matches the number of bounces.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)	iii. A set of numeral cards as for (i) and a number line drawn or painted on the chalkboard, without numerals as shown: **Note**: There is no dot at the starting point.	iii. **PROCEDURE**: Place the child in front of the number line. Enclose seven spaces between your hands, or run your finger over seven spaces, in each case starting from the beginning of the line. Say: "What number am I showing?" (seven) Give the child the appropriate set of numeral cards. Say: "Show me the numeral card that goes on this dot," (indicating the last dot of the number illustrated, i.e. the position for the numeral 7). Repeat, illustrating a different number on each occasion, to give the required number of test items. **Acceptable Response**: The child selects the appropriate numeral card.
	iv. A set of numeral cards as for (i) and a box of structured material, e.g. Cuisenaire rods. (Indicate the unit)	iv. **PROCEDURE**: Hold up a numeral card. Say: "Show me the rod that goes with this card." Hold up a rod. Say: "Show me the numeral card that goes with this rod." Repeat, using different rods and cards, to give the required number of test items. **Acceptable Response**: The child selects the appropriate rod or numeral card.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
11. **Writes numeral for cardinal number of a set.**	As in 10 for i, ii, iii, and iv. Pencil and paper, or Chalk	**PROCEDURE:** As for 10 (with at least five test items each for i, ii, iii and iv) except that, instead of selecting the appropriate numeral card, the child is requested to *write* the required numeral. Say (for i): "Write the numeral that goes with this set of things." (for ii): "Write the numeral that goes with this number of bounces." (for iii): "Write the numeral that goes on this dot." (for iv): "Write the numeral that goes with this rod." **Acceptable Response:** The child writes the appropriate numeral, on paper or chalkboard, for each activity.
12. **Uses ordinal numbers.**	i. A set of objects arranged in a line.	i. **PROCEDURE:** Place the line of objects before the child. Indicate the first object. Say: "This is the first thing." "Show me the sixth thing." "The last thing." "The third thing." "The second." "The ninth." The child points to the appropriate object. ** Then ask: "Which object is this?" (pointing to an object in the line). "And this?" "And this?" Repeat, to give the required number of test items. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
12. (continued)		**Acceptable Response**: The child says, for example: "The fourth one". "The second one." "The ninth one." using the appropriate ordinal words.
	ii. A number line without numerals, as shown: **Note**: There is no dot at the starting point.	ii. **PROCEDURE**: Say: "Look at the number line. Point to the third dot." "The seventh." "The first." Continue, indicating other dots. The child points to the appropriate dot. ** Say: "Now look at the number line. Which dot is this?" "And this?" "And this?" Indicate different dots, to give the required number of test items. **Acceptable Response**: The child says, for example: "The first dot," "the third," "the fifth," using the appropriate ordinal words.
	iii. A rubber ball (or a percussion instrument.)	iii. **PROCEDURE**: Place the ball near the child. Say: "Get the ball. Now bounce the ball; count as you go; stop after the sixth bounce."

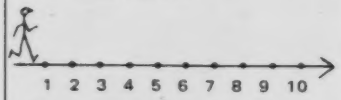
** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
12. (continued)		The child carries out the action correctly. Say: "Watch while I bounce the ball." ** Bounce the ball several times in quick succession. Say: "Which bounce did it stop at?" Repeat, making other numbers of bounces, to give the required number of test items. **Acceptable Response**: The child uses the correct ordinal word in each response, for example, "the third bounce." **Note**: If bouncing a ball presents a difficulty for the child, substitute tapping on a percussion instrument.

** The test proper begins here.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
13. **Orders sets (counting order).**	Containers with sets of one to ten objects, and, later, one to twenty, placed in random order. Numeral cards 1 - 10 (later 1 - 20) Suitable containers would be: saucers small shallow boxes ice-cream container lids.	**PROCEDURE**: Place the containers before the child in random order. Say: "Put the sets in order from one to ten." (Later, "from one to twenty.") Repeat, to give the required number of test items, presenting the child with the containers in a different order on each occasion. **Acceptable Response**: The child arranges the sets in counting order. He may first count to find the cardinal number of each set, and label it with the appropriate numeral card. **Note**: If the child fails in the test using sets one to ten, repeat using sets one to five. If, when commencing the test using sets one to twenty, the child fails to place them correctly repeat the test using sets one to ten.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
14. **Understands the relationship of one set to the next set in counting order.**	i. A number line with numerals to 10 and, later, to 20.  **Note**: There is no dot at the beginning of the line.	i. **PROCEDURE**: Place before the child a number line with numerals. Say: "Show me the number eight." Ask: "Can you show me the number nine? How many more is that?" or "How many more is nine that eight?" Repeat, using other pairs of consecutive numbers, to give the required number of test items. **Acceptable Response**: The child replies, without counting: "One more."
	ii. Containers with sets of one to ten objects and, later, one to twenty, placed in counting order. Each container is to be marked with the appropriate numeral.	ii. **PROCEDURE**: Place the containers in counting order before the child. Say: "Point to the sixth container. Now point to the seventh. How many more in that one?" (Indicate the seventh.) Repeat, indicating other pairs of adjacent containers, to give the required number of test items. **Acceptable Response**: The child replies without counting the members of the sets: "One more." **Note**: If the child wishes to count the members of the sets before responding, he may do so. This however indicates an intermediate stage of understanding.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
15. **Understands that a set has the same cardinal number when the members are re-arranged.**	Sets of objects within the range of ten and, later, of twenty. **Note:** The objects can be similar or dissimilar.	**PROCEDURE:** Place a set of objects before the child. Ask: "How many in the set?" ** When the child has answered correctly, rearrange the objects, spacing them widely or closely or vertically or randomly or in any pattern. Ask: "How many now?" "Are there as many now as there were before?" Re-arrange several times, on each occasion asking, "How many now?" "Are there as many now as there were before?" Repeat, using other sets of objects, to give the required number of test items. **Acceptable Response:** The child must respond correctly to both questions without re-counting. **Note:** The teacher may ask "How do you know?" The child should reply to indicate that no objects were added or taken away.

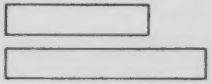
** The test proper begins here.

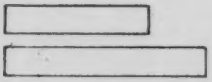
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
16. **(a) Understands and (b) uses the terms "more" and "less" ("fewer") (through comparison of sets).** **Note**: The word "less" is used when referring to *quantities*, the word "fewer" when referring to *numbers* of things (e.g. less butter, fewer apples).	(a) i. For each test item two sets of objects with different cardinal numbers. • At first within the range 1 - 10. • Later, within the range 1 - 20.	(a) i. **PROCEDURE**: Place two sets before the child. Ask: "Which set has more members?" ("objects", "things") "Which set has fewer members?" "Which number is more?" "Which number is less?" Repeat, using other sets, two at a time, to give the required number of test items. **Acceptable Response**: The child indicates the appropriate set, and states the correct number. **Note**: The child may use counting, pairing or visual judgement in comparing the sets.
	ii. For each test item a set of objects, and a further collection of objects from which the child can make other sets. (The objects can be white rods randomly arranged or in line formation.)	ii. **PROCEDURE**: Place the set before the child. Give him a box containing further objects. Say: "Make a set with more members than my set." "Which number is more?" "Make a set with fewer members than my set." "Which number is less?" Repeat, beginning with a different set on each occasion, to give the required number of test items.

(Continued over)

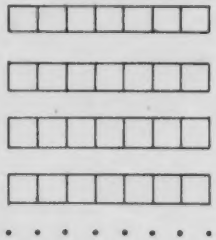
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
16. (continued)		It is suggested that in some repetitions white rods be used, randomly arranged, and in some, white rods in line formation, in the latter case telling the child to make a *line* with more *rods* instead of a *set* with more *members*. **Acceptable Response**: The child performs the appropriate action and indicates which number is more and which is less. **Note**: The child may use counting, pairing or visual judgement to make his sets and to arrive at his answers.
	iii. For each test item, two rows of white rods of different lengths (ends level) e.g. 	iii. **PROCEDURE**: Place two rows of white rods before the child. Ask: "Which row has more?" Then ask: "Which row has fewer?" (Two separate questions, to be answered separately.) Repeat, using other pairs of prepared rows, to give the required number of test items. **Acceptable Response**: The child indicates the appropriate row, in response to each question. It should not be necessary to count the white rods (since the ends of the rows are level) but the child may do so if he needs to.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
16. (continued)	iv. For each test item, two rods of different lengths (ends level). e.g. 	iv. **PROCEDURE**: Place the two rods before the child. (Indicate white is the unit.) Ask: "Which is more?" Then ask: "Which is less?" (Two separate questions, to be answered separately.) Repeat the test, using other rods, to give the required number of test items. **Acceptable Response**: The child indicates the appropriate rod, in response to each question.
	(b) i. For each test item, two sets of objects with different cardinal numbers. (The sets can be of white rods randomly arranged, or in line formation, for some of the tests.)	(b) i. **PROCEDURE**: Place two prepared sets of objects before the child. Ask: "Which set has more and which set has fewer members? (One question.) Repeat, to give the required number of test items, using other prepared sets two at a time. For some repetitions use white rods randomly placed, for others use white rods in line formation, in the latter case asking which line has more rods, and which has fewer. **Acceptable Response**: The child uses the words "more" and "fewer" ("less") in his response, for example: "The set has more; this set has fewer", indicating the appropriate sets, or (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
16. (continued)		"This line has more rods, this line has fewer rods," indicating the appropriate lines. If the child says: "This set has more; this set hasn't," he is at an intermediate stage. **Note:** Accept the word "less" for "fewer" in a child's response.
	ii. For each test item, two rods of different lengths (ends level). e.g. 	ii. **PROCEDURE**: Place two different rods before the child. (Indicate white is the unit.) Ask: "Which is more and which is less?" (One question.) Repeat, using other pairs of different rods, to give the required number of test items. **Acceptable Response**: The child uses the words "more" and "less" in his response, for example: "This one is more, this one is less," or "Seven is more, six is less." **Note:** A response of the type "This is seven, this is six" (i.e. numbers only) is not acceptable. If the child responds in this way, repeat the question to elicit if possible a response containing the words "more" and "less".

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
17. **Understands that all sets which are equivalent have the same cardinal number.**	i. Several equivalent sets, within the range 1 - 10. (The sets need not be arranged so as to show equivalence.)	i. **PROCEDURE**: Place before the child two of the prepared sets. Ask: "How many members in each set?" "Which is more, which is less?" The child indicates that both have the same number. Place a third set beside the other two. ** Ask: "Is this more? Is it less?" "What can you tell me about the three sets?" The child indicates that the three sets have the same number. Repeat, to give the required number of test items, using the rest of the prepared sets, two at a time. **Acceptable Response**: For each test item the child indicates that he realises the equivalence by a response such as "They are all the same number." "They all have the same number." "They are all sevens." If the child answers "No" to the questions regarding more, or less, say "Why do you think that?" **Note**: Accept the child's response if he uses "equal" or "the same number" to indicate equivalence. ** The test proper begins here. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
17. (continued)	ii. Several rows of white rods all having the same number. e.g. 	ii. **PROCEDURE:** Place before the child two of the rows of white rods, ends level. Ask: "Which is the longer row?" "Which row has more?" "Which is the shorter row?" "Which row has fewer?" "The child replies "They are both the same", or "They both have the same number." ** Now place a third row beside the other two. Ask: "Is this row longer?" "Shorter?" "Is this row more?" "Less?" The child indicates that the three rows have the same number. Repeat to give the required number of test items, using the rest of the prepared rows of white rods. **Acceptable Response:** For each test item the child indicates that he realises the equivalence by a response such as "They are all the same number." "They all have the same number." "They are all sevens." If the child answers "No" to the questions regarding more, or less, say "Why do you think that?" **Note:** Accept the child's response if he uses "equal" or "the same number" to indicate equivalence.

** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
17. (continued)	iii. A number of rods of the same colour.	iii. **PROCEDURE:** Place before the child two of the rods, ends level. Ask: "Which is the longer rod?" "Which is the shorter?" "Which is more?" "Which is less?" The child indicates the rods are the same. ** Now place the third rod beside the other two. Ask: "Is this rod longer?" "Shorter?" "Is this rod more?" "Less?" The child indicates the rod is the *same* as the other two. Repeat, to give the required number of test items, using the rest of the selected rods. **Acceptable Response:** For each test item the child indicates that he realises the equivalence by a response such as "They are all the same number." "They all have the same number." "They are all sevens." If the child answers "No" to the questions regarding more, or less, say "Why do you think that?" **Note:** Accept the child's response if he uses "equal" or "the same number" to indicate equivalence. ** The test proper begins here.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
18. **(a) Understands the meaning of, and (b) writes the equals sign.**	(a) Pairs of equivalent sets.	(a) **PROCEDURE**: †† Place before the child two equivalent sets of seven members each. Ask: "How many in this set?" "And the other set?" The child answers, "Seven" on both occasions. Write: 7 = 7 ** Ask: "What does this number sentence say?" "What does it mean?" "What is this sign called?" (indicating the equals sign) Repeat, to give the required number of test items, using different pairs of equivalent sets. **Acceptable Response**: For each test item the child should be able to state that, for example • seven equals seven • the sets have the same number • the sign is called "equals".

** The test proper begins here.
†† The number may be varied.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
18. (continued)	(b) i. Pairs of equivalent sets.	(b) **PROCEDURE:** i. **Objects.** Place before the child two equivalent sets of eight members each. Ask the child to count the objects and make the appropriate recording. Say: "Count these." "Write the number sentence." or "Write it down the way I did." Repeat, to give the required number of test items, using other pairs of equivalent sets. **Acceptable Response:** The child writes his response in the form: 8 = 8
	ii. A box of rods.	ii. **Rods.** • *With lines of white rods.* †† Place before the child two lines of white rods with eight in each line. Ask: "How many rods in this line?" "And this line?" The child answers "Eight" on each occasion. Write for the child: 8 = 8

†† The number may be varied.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
18. (continued)		Proceed as outlined in (a) and (b) above, making suitable adjustments to the wording. • *With pairs of rods of the same colour.* †† Place before the child two brown rods side by side. Ask the child to state the value of the rods (unit, white). Then write: 8 = 8 Proceed as outlined in (a) and (b) above, making suitable adjustments to the wording. Repeat, to give the required number of test items, using other numbers of white rods, and using pairs of rods of other colours. **Acceptable Responses:** (a) For each test item the child should be able to state that, for example, • eight equals eight • the rods, or lines of rods, represent the same number • the sign is called "equals". (b) The child writes his response in the form 8 = 8

†† The colour may be varied.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
19. **(a) Separates a set into subsets, and (b) understands part-whole relationships.**	(a) i. Sets of objects with members within the range of ten, and later, twenty.	(a) i. **PROCEDURE:** Place one of the sets before the child. Say: "Break this set into subsets" or, "into separate subsets." "How many subsets did you make?" Repeat to give the required number of test items. On each occasion the child is asked to repeat the action, breaking the set into other subsets, and different numbers of subsets. On each occasion ask: "How many subsets did you make?" **Acceptable Response:** The child uses all the members when making the subsets, indicating that he recognises that every member must belong to a subset. He states correctly the number of subsets made. The child may use attributes such as colour, shape, size or position, when selecting members for subsets; on the other hand he may now form subsets whose only attribute is that of cardinal number, the members being quite dissimilar.
	(a) ii. A box of rods.	(a) ii. **PROCEDURE:** Say: †† "Take out a yellow rod." (Specify yellow or longer.) "Make a pattern for this rod." "How many rods in the second line?" "Now make a different pattern for it." "How many rods this time?"

†† The colour may be varied.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
19. (continued)		Repeat, to give the required number of test items. On each occasion the child is asked to repeat the action, using in the second line different rods and different numbers of rods, and on each occasion being asked to state the number of rods in the second line. **Acceptable Response**: The child makes the patterns correctly and responds with the correct number. (Although the word "subset" has not been used in this activity, the child has in effect illustrated and counted the subsets of the set. The original rod represents the *set*, and the rods in the second line of the pattern represent the *subsets*.) **Note:** If it is desired to reinforce the concept of subsets in the context of rod illustrations then teaching, and testing, may include the following: Give the child the original rod as above (i.e. yellow or longer). Ask him to show the equivalent set of white rods, then to separate these into subsets. Request that a single rod be substituted for each subset of white rods. Form the rod pattern as in (a) ii above or invite the child to do so. Ask: "How many subsets did you make?"

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
19. (continued)	(b) A collection of coloured beads. A collection of coloured counters. A collection of coloured buttons. (Other objects may be used, the wording in the tests being varied accordingly.) **Note**: These tests use the attribute of colour. If desired, other attributes e.g. shape, size, texture, may be used, and the wording varied as required.	(b) **PROCEDURE**: i. Place before the child a set of ten beads – six red, one green, one pink, one blue, one yellow. Say: "Look at these beads." Ask: "How may beads are there altogether?" "How many red beads are there?" ** "Are there more beads than red beads?" ii. Place before the child a set of ten beads – six red, four blue. Ask: "How many beads are there altogether?" "How many red beads are there?" ** "Are there more beads that red beads?" iii. Place before the child a set of ten beads – six red, four blue. Ask: "How many beads are there altogether?" "How many red beads are there?" ** "Are there more red beads than beads?"

** The test proper begins here.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
19. (continued)		iv. Place before the child a set of ten counters – four red, four green, two blue. Ask: "How many counters are there altogether?" "How many green counters are there?" ** "Are there more green counters than counters?" v. Place before the child a set of ten buttons – three green, three yellow, three red, one blue. Ask: "How many buttons are there altogether?" "How many yellow buttons are there?" ** "Are there more yellow buttons than buttons?" "Are there more buttons than yellow buttons?" If ten items are desired, five futher test items of a similar nature may be devised. **Note**: With older children the first two questions should be omitted on each occasion, and the third question only should be asked. With younger children the first two questions may be asked, to ensure that the child is not confused by the wording of the final question. It is found that often children tend to answer the question they *think* is being asked, for example, in ii, "Are there more blue beads than red beads?" If a child succeeds in a number of test items using the three questions, he should then be given a number of other test items of a similar nature using questions of the third type only.

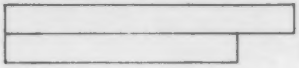
** The test proper begins here.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
19. (continued)		**Acceptable Response:** The child answers correctly the third question (marked **) in each test item to indicate that he understands that the whole is greater than the part, or that the cardinal number of the set is greater than that of the subset. (The part is less than the whole, the cardinal number of the subset is less than that of the set.) He may state merely "yes" or "no" in answer to the question, or may answer in the form "Yes, because there are ten beads, and four red beads." If desired, when a child has answered just "yes", or "no", the tester may continue: "How do you know?" or "Why do you think that?" The child may then indicate that he understands the relationship of the whole to the part by statements such as the following: "There are ten beads, but only four blue beads." "First you mean *all the counters,* then you look at *just the red ones.*"

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
20. **Knows that zero is the cardinal number and nought is the numeral for the set that has no members.** **Note**: The cardinal numbers and their associated numerals have the same names except in the case of the empty set, i.e. the cardinal number is *zero* and the name of the numeral is *nought*. (This is the convention defined in the N.S.W. mathematics syllabus.)	i. A set of three objects and a set of numeral cards 0 - 10.	i. **PROCEDURE**: Place the set of objects before the child, and give him the numeral cards. Say: "How many in this set?" (three) "Find the right numeral card." (3) "What is its name?" (three) Remove one object. "How many in this set?" (two) "Find the right numeral card." (2) "What is its name?" (two) Remove one object. "How many in this set?" (one) "Find the right numeral card." (1) "What is its name?" (one) ** Remove the last object. "How many in this set?" (zero, none, nothing) "Find the right numeral card." (0) "What is its name?" (nought) If a child responds by saying "none", "nothing", "empty set", ask "Is there another word?" **Acceptable Response**: The child responds as outlined. **Note**: It is not possible to repeat this procedure to give five or more test items in different forms. The only variation possible is to use different sets of three objects.

** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
20. (continued) It is not vital that children maintain the distinction between the names *nought* and *zero*, merely that they are conversant with them. The concept of the empty set, however, *is* important.	ii. A box of rods. Pencil and paper An incomplete pattern for the orange rod: orange side by side with brown 	ii. **PROCEDURE**: Place the incomplete pattern before the child. Give him pencil and paper and have available a box of rods. State that white is the unit. Say: "Complete the pattern." (red rod) "What number goes with eight to make ten?" (two) "Write it down." (2) "What is it called?" (two) Replace the brown rod with blue. "Complete the pattern." (white rod) "What goes with nine to make ten?" (one) "Write it down." (1) "What is it called?" (one) ** Replace the blue rod with an orange rod. Say: "What goes with ten to make ten?" (nothing) When the child says "nothing" or "no rod", ask "Is there another name?" (zero). Continue: "Write it down." (0) "What is it called?" (nought) **Acceptable Response**: The child responds as outlined. **Note**: It is not possible to repeat this procedure to give five or more test items in different forms. If varied by selecting other rods as the starting rod, the test is merely lengthened.

** The test proper begins here.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
21. **(a) Combines two sets to form a new set and (b) understands that this is an action of addition.**	(a) i. Several sets of objects (with appropriate numbers of members).	(a) i. **PROCEDURE**: Place two of the sets before the child. Say: "Combine these two sets." ("Put together . . .") "How many in the new set?" Repeat, to give the required number of test items, using other pairs of sets. **Acceptable Response**: The child performs the action, and states the number, correctly.
	ii. A box of rods.	ii. **PROCEDURE**: Place the box of rods before the child. Give the child two suitable rods. Say: "Place these rods end-to-end." "Make a pattern." (that is, measure the rods). "Which rod did you use to make the pattern?" Repeat, to give the required number of test items, using other pairs of rods. **Acceptable Response**: The child makes the pattern correctly, and names the rod which equals the length of the nominated rod.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
21. (continued)	(b). i. Several sets of objects (with appropriate numbers of members) as in (a) i above.	(b) i. **PROCEDURE**: Place two of the sets before the child. Say: "Combine these two sets." "Tell me the number sentence." Repeat, to give the required number of test items, using other appropriate sets. **Acceptable Response**: The child gives the correct number sentence.
	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: Place the box of rods before the child. Give him two suitable rods. Say: "Place the rods end-to-end." "Make a pattern and tell me the number sentence." Repeat, to give the required number of test items, using other appropriate rods. **Acceptable Response**: The child states the number sentence in a form similar to one of the following: "Three plus two equals five." "Three and two equals five." "Two added to three is equal to five." **Note**: It is assumed that the terms "adding" and "addition" have been used in the teaching process.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
21. (continued) **Note**: Regardless of the number of addends the actual process of addition involves combining only two sets at a time.		The teacher may continued the test procedure by asking: "What have we been doing?" or "What action is that?" or "What does *plus* tell us?" The child should be able to respond by saying, "Adding" or "Addition". Tests may be given where a further set is combined with the "new set" previously made. 5 e.g. (3 + 2) + 4 = 9 i. *With sets of objects.* Give the child a set of three and a set of two; when he has combined and counted these, give him a further set of four. Then ask for the total and the number sentence. ii. *With rods.* Give the child two rods to measure; ask for the total and the number sentence. Then give the third rod, to be placed end-to-end with the first two. Ask for the new number sentence.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
22. **Understands that whatever the order in which sets are combined the total number of members is the same.**	i. Four sets of objects – the total not to exceed ten.	i. **PROCEDURE**: Place the four sets before the child. Ask: "How many in these sets altogether?" The child responds by giving the correct number. ** Place the sets in a different order and say: "Now how many?" Continue to re-arrange the order of the sets, and on each occasion ask: "Now how many?" Repeat, to give the required number of test items, using four different sets on each occasion. **Acceptable Response**: The child gives the correct number without recounting the members.
	ii. A box of rods.	ii. **PROCEDURE**: Place before the child four rods end-to-end (total length not longer than orange). Indicate the unit in the number stage. Say: "Measure these rods." (with one rod) "How long are they?" or "What do they equal?"

** The test proper begins here.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
22. (continued)		The child responds in colour or in number, according to stage. For example, "Blue" in pre-number stage, or "Nine" in number stage. ** Remove the measuring rod, re-arrange the original four rods, then ask: "Now how long?" or "Now how many?" Continue to change the order of the rods, asking the same question after each re-arrangement. Repeat, to give the required number of test items, using four different rods on each occasion. **Acceptable Response**: The child responds correctly without re-measuring the rods.
23. **(a) Separates a set into two subsets, removes one subset, and (b) understands that this is an action of subtraction.**	(a) i. Sets of objects.	(a) i. **PROCEDURE**: Place a set of objects before the child. Ask: "How many are there?" "Separate this set into two subsets and remove one subset." Ask: "How many did you remove?" "How many are left?" Repeat, to give the required number of test items, using other sets of objects.

** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
23. (continued)		**Acceptable Response**: The child carries out the actions and states the numbers correctly.
	(a) ii. A box of rods.	(a) ii. **PROCEDURE**: Place one rod before the child (preferably a rod longer than yellow). Indicate the unit. Ask: "What rod is this?" "What is its number?" Say: "Make a pattern for it using two more rods." The child selects two rods and makes a pattern. Say: "Place one of the shorter rods on top of the long one." Ask: "What is the number of the rod on top?" "What is the number of the rod which fits in the space?" Repeat, to give the required number of test items, using other rods and patterns. **Acceptable Response**: The child carries out the actions and states the numbers correctly.
	(b) i. A set of objects.	(b) i. **PROCEDURE**: Place the objects before the child. Ask: "How many are there?" Say: "Separate this set into two subsets and remove one subset." Say: "Tell me the number sentence." (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
23. (continued)		Repeat, to give the required number of test items, using other sets of objects. **Acceptable Response**: The child states the number sentence in a form similar to one of the following: "Seven minus two equals five." "Seven take away two is five."
	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: Place one rod before the child (preferably a rod longer than yellow). Indicate the unit, (white). Ask: "What rod is this?" "What is its number?" "Make a pattern for it using two more rods." When the child has made the pattern, say: "Place one of the shorter rods on top of the long one." "Tell me the number sentence." Repeat, to give the required number of test items, using other rods and patterns. **Note**: If the child selects the second rod to place on top, the conventional subtraction structure will appear in reversed form. **Acceptable Response**: The child states the number sentence in a form similar to one of the following:

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
23. (continued)		"Seven minus two is five." "Seven minus two equals five." **Note**: It is assumed that the terms "taking away" "subtracting" and "subtraction" have been used in the teaching process. The teacher may continue the test procedure by asking: "What have we been doing?" "What action is that?" or "What does *minus* tell us?" The child should be able to respond by saying "Taking away", "Subtracting", or "Subtraction".
24. **Compares two sets by pairing to find the difference between them, and understands that this is also an action of subtraction.**	i. Sets of objects with different numbers of members. (not more than ten per set)	i. **PROCEDURE**: Place two sets of objects before the child, each set containing a different number of objects. Say: "See if these sets match." (or "Pair the elements of these sets.") Ask: "Are they the same in number or are they different?" "What is the difference?" "Tell me the number sentence." Repeat, to give the required number of test items, using other sets presented two at a time. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
24. (continued)		**Acceptable Response**: The child carries out the action of pairing the members of the sets and noting the objects unpaired, he states the correct numbers, and he gives the number sentence correctly in subtraction form. If he can state the difference but cannot give the subtraction sentence he is at an intermediate stage. **Note**: It is assumed that the terms "difference", "comparing", "subtracting" and "subtraction" have been used in the teaching process. The teacher may continue the test procedure by asking: "What have we been doing?" "What action is that?" or "What does *minus* tell us?" The child should be able to respond by saying "Comparing", "Subtracting", "Subtraction" or "Finding the difference".
	ii. Pairs of rods of different lengths.	ii. **PROCEDURE**: Place before the child two unequal rods. Say: "Put these two rods side by side." Ask: "Are they the same or are they different?" Indicate that white is the unit. Ask: "What is the difference?" "Tell me the number sentence." Repeat, to give the required number of test items, using other pairs of unequal rods.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
24. (continued)		**Acceptable Response**: The child carries out the action of comparing rods, and noting or measuring the length of the "gap", he states the correct number for the difference, and he gives the correct number sentence in subtraction form. **Note**: The test may be extended as explained in the Note for i. above.
25. **Understands that there is an inverse relationship between the operations of addition and subtraction, and of subtraction and addition.**	i. An assortment of objects.	i. **PROCEDURE**: Place a set of seven objects before the child. (Do not *actually* add or remove any objects during the course of the testing, as the test is of a mental process or understanding.) Ask: "How many in the set?" "How many would there be if I added three and then removed (subtracted) the same three?" "How many would there be if I added three and then removed (subtracted) three others?" "How many would there be if I removed (subtracted) three and then added the same three?" "How many would there be if I removed (subtracted) three and then added three others?" Repeat, to give the required number of test items, using other sets and numbers. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
25. (continued)		**Acceptable Response**: The child responds by answering "seven" to *all* the questions (in the example cited) and other appropriate numbers (to all the questions in each test item) *without carrying out the physical actions with objects.* The teacher may continue each test item by asking: "How do you know?" The child may respond with answers such as: "It's the same as we started with." "If we add something and then take it away it makes no difference." "If we add a number and subtract the same number it makes no difference." "If you take something away and then put it back, it's the same as it was at first." Any response is acceptable which shows that the child understands that one operation "undoes" the other.
	ii. A box of rods.	ii. **PROCEDURE**: Give the child a black rod. Indicate that white is the unit. (Do not actually add or remove any rods during the course of the testing, as the rest is of a mental process or understanding.) Ask: "What number does this rod represent?" †† "What would be the answer if we add a light-green rod and subtract a light-green rod?" "What would be the answer if we subtract a light-green rod and a light-green rod?"

†† The colour may be varied.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
25. (continued)		Repeat, to give the required number of test items, using other rods and numbers. **Acceptable Response**: The child responds "seven" (in the example cited) without carrying out the physical actions with rods. The teacher may continue each test item by asking: "How do you know?" The child may respond with answers such as: "It's the same rod we started with." "If we add a rod and subtract the same rod it makes no difference." Any response is acceptable which shows that the child understands that one operation "undoes" the other.
26. **Understands that from one addition fact, other addition facts and subtraction facts can be derived.**	i. Sets of objects. (up to twenty objects, preferably identical)	i. **PROCEDURE**: Place before the child a set of seven objects. Say: "Separate this set into two subsets." "Tell me the number sentence." ** "Tell me as many other number sentences about this as you can think of." (It may be necessary to prompt to elicit subtraction sentences.) Repeat, to give the required number of test items, starting on each occasion with a set containing a different number of members.

** The test proper begins here.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
26. (continued)		**Acceptable Response**: After giving his initial number sentence correctly, for example "seven equals five plus two", the child gives other number sentences derived from it, such as: $7 = 2 + 5$ $\quad$ $7 - 2 = 5$ $5 + 2 = 7$ $\quad$ $7 - 5 = 2$ $2 + 5 = 7$ $\quad$ $2 = 7 - 5$ $7 - 5 - 2 = 0$ $\quad$ $5 = 7 - 2$ The minimum requirement for success in each test item is two addition and two subtraction forms. **Note**: For the derived number sentences, the child may manipulate the objects, or may work mentally. He may state the number sentences orally, or give them in written form. He may write his first number sentence, and state the others orally as he refers to the recording.
	ii. A box of rods.	ii. **PROCEDURE**: Place before the child a brown rod. Say: "Make a pattern for the brown rod, using two rods in the second line." "Read the pattern." (The reading will be given in colour for pre-number stage, in number for number stage.) ** "Tell me as many other sentences about this pattern as you can think of." Repeat, to give the required number of test items, using other rods and patterns.

** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
26. (continued)		**Acceptable Response**: The child responds by giving, in the colour stage, sentences such as the following, all derived from an initial sentence, "brown equals yellow plus light-green": "Yellow plus light-green equals brown." "Light-green plus yellow equals brown." "Brown equals light-green plus yellow." "Brown minus light-green equals yellow." "Brown minus yellow equals light-green." "Yellow equals brown minus light-green." "Light-green equals brown minus yellow." "Brown minus light-green minus yellow equals nothing." and sentences, in the number stage, such as: $5 + 3 = 8$ $3 + 5 = 8$ $8 = 3 + 5$ $8 - 3 = 5$ $8 - 5 = 3$ $5 = 8 - 3$ $3 = 8 - 5$ $8 - 3 - 5 = 0$ The minimum requirement for success in each test item is two addition and two subtraction forms. **Note**: The child may manipulate the rods, or make mental transpositions. He may state the number sentences orally, or give them in written form. He may write his first number sentence and state others orally as he refers to his recording.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
27. **(a) Combines several sets, each with the same cardinal number, to form a new set, and (b) understands that this action of repeated addition is multiplication.**	(a) i. A large collection of objects from which to make equivalent sets.	(a) i. **PROCEDURE**: †† Place before the child four sets, each with two members. Say: "Combine these four sets to make a new set." "How many in the new set?" Repeat, to give the required number of test items, using other groups of equivalent sets. **Acceptable Response**: The child performs the actions and states the numbers correctly.
	(a) ii. A box of rods.	(a) ii. **PROCEDURE**: †† Place before the child four red rods. Say: "Place these end-to-end and then complete the pattern." "What do they measure?" Repeat, using other sets of rods of the same colour, to give the required number of test items. **Acceptable Response**: The child makes the pattern correctly and gives the correct value of the measuring rod.

†† The number may be varied. SS

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
27. (continued)	(b) i. A large collection of objects from which to make equivalent sets.	(b) i. **PROCEDURE**: Carry out the procedure (a) i. Say: "Tell me the number sentence." Repeat, using other sets and numbers, to give the required number of test items. **Acceptable Response**: The child states the number sentence in a form similar to one of the following: "Four twos are eight." "Four twos equal eight." "Four lots of two equal eight." "Four times two equals eight." **Note**: If the child uses an addition form say, "Tell me another way."
	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: Carry out procedure for (a) ii. Say: "Tell me the number sentence." Repeat, using other "train" patterns, to give the required number of test items. **Acceptable Response**: The child states his number sentence in a form as indicated in (b) i.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
28. **(a) Partitions a set into two equivalent subsets, and (b) understands that this is the action for finding halves.** **Note**: Procedure (b)i may be presented immediately after (a) i if desired, and Procedure (b) ii may be presented immediately after (a) ii.	(a) i. A collection of objects.	(a) i. **PROCEDURE**: Place before the child a set of objects with an even number of members. Say: "Separate this set into two subsets each with the same number." (or, "into two equivalent subsets.") Ask: "How many in each (subset)?" Repeat, to give the required number of test items, using other sets which have an even number of members. **Acceptable Response**: The child performs the action and states the number correctly.
	(a) ii. A box of rods.	(a) ii. **PROCEDURE**: Place before the child a rod representing an even number. (Indicate white is the unit.) Say: "Make a train of two rods for this rod." Ask: "What colour is the train?" "What number is each train rod?" Repeat, using other rods representing even numbers, to give the required number of test items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
28. (continued)		**Acceptable Response:** The child makes the train and states the number correctly.
	(b) i. A collection of objects.	(b) i. **PROCEDURE:** Carry out the procedure for (a) i. Ask: "What did we do to the set?" "What have we found out about the set?" or "Tell me something about the subsets." or "Tell me something about the *parts* of the set." Then say: "Tell me a number sentence about what we did." Repeat, using other sets which have an even number of members, to give the required number of test items. **Acceptable Response:** The child may respond in any way similar to the following: "We halved the set." "We found the two halves of the set." "Each part is a half." "Five is half of ten." (for example). If the child says: "We made two subsets with the same number" (or "two equivalent subsets"), continue questioning to ascertain whether he knows the terms *half, halves* or *halving.* (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
28. (continued)	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: Carry out the procedure for (a) ii. Ask: "What did we do to the rod?" or "What have we found out about it?" or "Can you tell me something about each train rod?" Then ask: "Can you tell me a number sentence about this?" Repeat, using other rods which have two-rod trains, to give the required number of test items. **Acceptable Response**: The child may respond in any way similar to the following: "We halved the rod." "We found the two halves." "Each of these rods is a half." "Five is half of ten." (for example) If the child makes a response such as: "We made a yellow train", continue questioning to ascertain whether he knows the terms *half, halves* or *halving.*

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
29. **(a) Understands and (b) uses the terms *odd* and *even*.** **Note:** If desired, the test items for the term *even* may be presented before those for *odd*.	(a) i. Objects from which sets can be formed.	(a) i. **PROCEDURE:** Place the objects before the child. Say: "Make me a set with an odd number of members." "Now make me another 'odd' set." Repeat the instruction, to give the required number of test items. **Acceptable Response:** The child makes sets with odd numbers of members. **Note:** The teacher may continue by asking: "How do you know that is an odd number?" The child indicates his understanding by a response similar to the following: "I can't put the set in twos, there's always a two not finished." "There is one over if I put the set in pairs." "You can't get half of that set" (meaning, of course, that there is no whole number which is half of an odd number).
	(a) ii. A box of rods.	(a) ii. **PROCEDURE:** Place the box of rods before the child. Indicate that white is the unit. Say: "Show me a rod for an odd number." "Now show me another (for an odd number)."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
29. (continued)		Repeat to give the required number of test items. After each rod is shown, say: "What number does that rod represent?" "How do you know that number is odd?" **Note**: If ten test items are required, the child will have to show some of the rods more than once. **Acceptable Response**: The child selects a white, light-green, yellow, black or blue rod and states the numerical value. He indicates his understanding by a response similar to the following: "You can't make a red train for that rod." "You can't find two rods the same colour to equal that length."
	(a) iii. Objects from which sets can be made.	(a) iii. **PROCEDURE**: Place the objects before the child. Say: "Make me a set with an even number of members." "Now make me another 'even' set." Repeat to give the required number of test items. **Acceptable Response**: The child makes sets with even numbers of members.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
29. (continued)		**Note**: The teacher may continue by asking: "How do you know that is an even number?" The child indicates his understanding by a response similar to the following: "I can put the set in pairs (twos)." "There is none over when I make pairs." "I can find half of that set." (indicating that he knows that half an even number is always a whole number).
	(a) iv. A box of rods.	(a) iv. **PROCEDURE**: Place the box of rods before the child. Indicate that white is the unit. Say: "Show me a rod for an even number." "Now show me another (for an even number)." Repeat to give the required number of test items. After each rod is shown say: "What number does that rod represent?" "How do you know that number is even?" **Note**: If ten test items are required, the child will have to show some of the rods more than once. **Acceptable Response**: The child selects a red, crimson, dark-green, brown or orange rod and states the numerical value. He indicates his understanding by responses similar to the following: "You can make a red train for that rod." "You can find two rods the same colour to equal that length." (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
29. (continued)	(b) i. Several sets (five or ten) some containing odd numbers of members, some containing even numbers of members.	(b) i. **PROCEDURE**: Place the sets before the child. Say: "Tell me which sets are odd and which sets are even." (One instruction, not two.) **Acceptable Response**: The child points to each set in turn and uses the words *odd* and *even*, saying, for example: "This set (number) is odd and this set (number) is even." **Note**: The child may arrange the objects or count them.
	(b) ii. Several rods (five or ten), some representing odd numbers, some representing even numbers. (Some colours may be include twice.)	(b) ii. **PROCEDURE**: Place the rods before the child. Indicate that white is the unit. Say: "Tell me which rods stand for (represent) even numbers and which stand for odd numbers." (One instruction, not two.) **Acceptable Response**: The child points to each rod in turn, and uses the words *odd* and *even* saying, for example: "This number is odd and this number is even."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
29. (continued) **Extension:** Recognises *odd* and *even* numbers. If a child shows mastery of the work outlined in (a) and (b) above, this extension may be given.	A pencil A variety of cards with numerals as shown: In the range 1 - 10: e.g. 4 5 10 7 3 5 6 1 4 9 8 2 3 3 8 5 1 7 9 6 4 2 8 4 10 3 In the range 1 - 20: e.g. 4 18 2 11 17 16 19 7 20 13 12 5 10 15 6 20 14 17 18 13 12 19 10	**Extension:** i. **PROCEDURE:** Place a card before the child. Say: "Circle all the numerals for odd numbers." (or "all the odd numbers.") Show further cards for the odd numbers, to give the required number of test items, first in the range 1 - 10 and, later, 1 - 20. **Acceptable Response:** The child circles *all* the numerals for odd numbers on the card, for each test item. ii. **PROCEDURE:** Repeat the procedures outlined for the odd numbers substituting the word "even" for "odd" throughout. **Acceptable Response:** The child circles *all* the numerals for even numbers on the card, for each test item.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
30. **(a) Partitions a set into three, four, five, . . . , equivalent subsets and (b) understands this as the action for finding thirds, quarters, fifths, . . .**	A collection of objects.	**PROCEDURES:** i. **Thirds.** Repeat the procedures outlined in 28 (a)i, (b)i, (a)ii, (b)ii, adapting the words to give directions for sets with numbers divisible by three which are to be partitioned into three equivalent subsets, each of these being a third of the set, so that the child may make a statement in a form similar to one of the following: "We separated the set into thirds." "We found the three thirds of the set." "Each part is a third." "Three is a third of nine." (for example). ii. **Quarters.** Repeat the procedures outlined in 28 (a)i, (b)i, (a)ii, (b)ii, adapting the words to give directions for sets with numbers divisible by four to be partitioned into four subsets, each of which is a quarter (a fourth) so that the child may state: "We separated the set into quarters." "We found the four quarters of the set." "Each part is a quarter." "Two is a quarter of eight." (for example). iii. **Fifths.** Repeat the procedures outlined in 28 (a)i, (b)i, (a)ii, (b)ii, adapting the words to give directions for sets with numbers divisible by five which are to be partitioned into five subsets, each of these being a fifth, so that the child may state: Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
30. (continued)		"We separated the set into fifths." "We found the five fifths of the set." "Each part is a fifth." "One is a fifth of five." (for example). iv-viii. **Sixths, sevenths, eighths, ninths, tenths.** As for fifths above, substituting *six* and *sixths, seven* and *sevenths, eight* and *eighths, nine* and *ninths, ten* and *tenths* as required, where the words *five* and *fifths* are given. **Acceptable Response:** The child responds as indicated above. **Note:** Children frequently find difficulty in separating a set into equivalent subsets, and may instead make the required number of subsets with different numbers of members. For example, 4, 3 and 2 instead of 3, 3 and 3. This happens when the child has no remembered number fact to use and "trial and error" is unsuccessful. It is desirable to teach children a reliable technique for forming equivalent subsets. This is the "one for you, one for you, one for you, . . . , " sharing technique. Use the appropriate number of boxes or other containers. The child should place *one* object in each box, then repeat the procedure, one object to each box, until all the objects are distributed. He should understand that for success each "round" must be completed and there must be no "remainder" objects.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
31. **(a) Partitions a set into a given number of subsets to find out how many in each subset, and (b) understands this as the action of sharing.** This is the form of division most commonly used in problem-solving situations, in the early stages. **Note:** Procedure (b) i may be presented immediately after (a) i if desired Procedure (b) ii may be presented immediately after (a) ii if desired.	(a) i. A collection of objects. (a) ii. A box of rods.	**Six shares** (a) i. **PROCEDURE:** Place before the child a set of objects whose number is divisible by six. Say: "Separate this set into six equivalent subsets" (or, "six subsets with the same number in each.") Ask: "How many in each subset?" Repeat using other appropriate sets, and other numbers of subsets ("even" division) to give the required number of test items. (See Note, page 87.) **Acceptable Response:** The child makes correctly the specified number of subsets, and states the number of objects in each. **Note:** The child may use the technique explained in the Note on page 85. (a) ii. **PROCEDURE:** Place before the child a rod, or rods, representing a number divisible by six. (Indicate that white is the unit.) Say: "Make a train with six rods in it for this rod" (or "for these rods"). "What is the number of each train-rod" or "What colour is each train-rod?" "What number is that?"

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
31. (continued)		Repeat, using other appropriate rods for which trains with a specified number of rods can be made, to give the required number of test items. **Acceptable Response**: The child makes the required train and states the number value of each rod in it. **Note**: The procedures used in Objective 31 involve the same activities as used in Objective 30. In Objective 30, the understanding is of *fractional parts*. Here in Objective 31, the understanding is of *sharing*.
	(b) i. A collection of objects.	(b) i. **PROCEDURE**: When the child has carried out the procedure with objects as outlined in 31 (a)i above, say: "If these objects were lollies, and we shared them amongst six children, how many would each child get?" or "What would each child's share be?" or "Show me what one person's share would be." "Can you tell me a number sentence for this sharing story?" **Acceptable Response**: The child observes the six subsets and states the number in each. He states the number sentence in a form similar to the following: "Six twos equal twelve." or "Twelve has six twos." (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
31. (continued)	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: When the child has carried out the procedure with rods, outlined in 31 (a)ii, point to the rod or rods for which the train has been made and say: "If this rod (these rods) were lollies and we shared them among six children, how many would each child get?" or "What would each child's share be?" or "Can you tell me a number sentence for this 'sharing' story?" **Acceptable Response**: The child observes the six rods in the train and states the number value of each. He gives the number sentence in the form "Six twos equal (are) twelve" or "Twelve is six twos." **Five shares.** **PROCEDURE**: Repeat all the activities outlined in (a)i, (a)ii, (b)i, (b)ii, using sets of objects whose number is divisible by five, or rods representing numbers divisible by five. The child may use the sharing technique outlined in the Note on page 85. **Acceptable Response**: (a) The child makes the five subsets and states the number in each. (b) He gives the number sentence in a form similar to the following: "Five twos equal ten." or "Ten has five twos."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
31. (continued)		**Three shares, two shares, four shares, . . .** **PROCEDURE:** Adapt all the activities so that the numbers used are divisible by three, or two, or four or . . . The child may use the sharing technique suggested on page 85. **Acceptable Response:** As outlined for other numbers of shares, substituting appropriate numbers.
Extensions: (c) Verbalises this understanding.	(c) The structures made by the child in (a) and (b) above.	(c) **PROCEDURE:** Follow up the procedures outlined by asking the child to explain his answer. **With sets of objects** In response to the question "How do you know what each person's share is?" the child should indicate that he understands that each subset corresponds to a person and the number in the subset represents the person's share. **With rods.** In response to the question "How do you know what each person's share is?" the child should indicate that he understands that each train-rod corresponds to a person, and that the number value of the train-rod represents the person's share. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
31. (continued)		**Acceptable Response:** The child responds as indicated. **Note:** Although the procedures for various numbers of shares are set out, it is not necessary to give a set of test items for each number of shares (i.e. test items on six shares, test items on four shares and so on). The set of test items given should involve a variety of numbers.
32. **(a) Partitions a set into equivalent subsets of a given number, to find out how many subsets are formed and (b) understands this as an action of division.**	(a) i. A collection of objects.	(a) i. **PROCEDURE:** Place before the child a set of objects whose number is divisible by three. Say: "Separate this set into subsets of three." "How many subsets did you make?" or "groups of three." Repeat, using sets with numbers divisible by four, two, . . . , to give the required number of test items. **Acceptable Response:** The child partitions the set correctly and states the number of subsets made.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
32. (continued) This is the form of division which asks (for example) "How many threes in twelve?" (Four threes in twelve) Note: Procedure (b)i may be presented after (a)i if desired Procedure (b)ii may be presented after (a)ii if desired.	(a) ii. A box of rods. (b) i. A collection of objects.	(a) ii. **PROCEDURE:** Place before the child a rod, or rods, representing a number divisible by three. (Indicate that white is the unit.) †† Say: "Make a light-green train for that rod (those rods)." "How many rods in the train?" Repeat, using other rods representing numbers divisible by four, two, . . . , to give the required number of test items. **Acceptable Response:** The child makes the train correctly and states the number of rods in the train. (b) i. **PROCEDURE:** When the child has carried out the procedure outlined in 32 (a)i say: "How many threes in that number?" Repeat this form of questioning throughout the required number of test items. **Acceptable Response:** The child observes the subsets and states, for example, "There are *four* threes in twelve."

†† The colour may be varied.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
32. (continued) **Note:** This is the form of division commonly used in testing multiplication facts and in algorisms.	(b) ii. A box of rods.	(b) ii. **PROCEDURE:** When the child has carried out the procedures outlined in 32 (a)ii ask: "How many threes in that number?" Repeat this form of questioning throughout the required number of test items. **Acceptable Response:** The child observes the rods in the train and states, for example: "There are *four* threes in twelve."
33. **(a) Removes from a set equivalent subsets with a given number of members to find out how many times this can be done and (b) understands that this repeated subtraction can give an answer to a division question.**	(a) i. A collection of objects.	(a) i. **PROCEDURE:** Place before the child a set of objects whose number is divisible by four. Say: "Remove (a subset of) four objects. Remove another (subset of) four. Continue removing fours until none is left." Ask: "How many subsets (groups of four) did you remove?" Repeat to give the required number of test items, using sets of objects whose numbers are "evenly" divisible (i.e. no remainders), and inserting the appropriate numbers, in instructions and questions. **Acceptable Response:** The child carries out the actions and states the number correctly.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
33. (continued)	(a) ii. A box of rods.	(a) ii. **PROCEDURE**: Place before the child a rod, or rods, representing a number divisible by four. (Indicate that white is the unit.) Say: "Make a crimson train for this." "Remove one train-rod. Remove another. Continue removing train-rods until none is left. How many did you remove?" Repeat, to give the required number of test items, using rods representing numbers which are "evenly" divisible, and inserting the appropriate colour words in instructions and questions. **Acceptable Response**: The child carries out the actions and states the number correctly.
	(b) i. A collection of objects.	(b) i. **PROCEDURE**: When the child has carried out the procedures outlined in 33 (a)i, ask: "How many fours in that number?" Repeat this form of questioning throughout the required number of test items. **Acceptable Response**: The child observes the subsets removed and states, for example, "There are *four* fours in sixteen." (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
33. (continued)		(b) ii. **PROCEDURE**: When the child has carried out the procedures outlined in 33 (a)ii, ask: "How many fours in that number?" Repeat this form of questioning throughout the required number of test items. **Acceptable Response**: The child observes the rods that have been removed and states, for example, "There are *four* fours in sixteen." **Note**: It may be advisable in both (b)i and (b)ii to ask further: "How do you know?" The child should reply, in his own words, to the effect that (for example) since four fours can be subtracted *from* sixteen, there must be four fours *in* sixteen.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. Records, in number sentences using the signs + – x =, the actions for addition, subtraction, multiplication, finding fractional parts and division. **Note:** These actions were tested in Objectives 21, 23, 24, 26, 27, 28, 30, 31, 32 and 33. The items which follow (i - x) test the recording of the actions.		

Each test item should be presented at the appropriate stage in the learning process.

i. Records the combining of two sets (addition) (Recording of Objective 21).	i. Pencil and paper A number of sets of objects with appropriate numbers of members.	i. **PROCEDURE:** **Sets:** Place two of the sets before the child. Say: "Combine these two sets." "How many in the new set?" (This question may be omitted.) "Write the number sentence."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Repeat, using other pairs of sets, to give the required number of test items.
	Pencil and paper	**Rods:**
	A box of rods.	Place the box of rods before the child and give him two suitable rods, stating that white is the unit.
		Say: "Place these rods end-to-end. Make a pattern." "Read the pattern in colour." (This instruction may be omitted.) "Write the number sentence."
		Repeat, using other pairs of rods, to give the required number of test items.
		Acceptable Response:
		The child performs the action and writes the number sentence correctly, using the form 5 + 3 = 8.
		Note: If the child is uncertain, say "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
ii. Records the removal of a subset (subtraction) (Recording of Objective 23.)	ii. Pencil and paper Sets of objects.	ii. **PROCEDURE:** **Sets:** Place the set of objects before the child. Say: "Separate this set into two subsets and remove one subset."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Ask: "How many did you start with? How many did you remove? How many are left?" (These questions may be omitted.) Say: "Write the number sentence." Repeat, using other sets and subsets, to give the required number of test items.
	Pencil and paper A box of rods.	**Rods** Place a rod before the child, stating that white is the unit. Say: "Make a pattern for this rod, using two more rods." Ask: "What rods did you use? What numbers do they represent?" (These questions may be omitted.) Say: "Place one of the shorter rods on top of the long rod." "Write the number sentence." Repeat, to give the required number of test items, commencing with other rods and making other patterns, then placing one of the shorter rods on top of a long rod. **Acceptable Response:** The child performs the action and writes the number sentence correctly, using the form $8 - 5 = 3$. **Note:** If the child is uncertain, say "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		
iii. Records the comparing of two sets (difference) (Recording of Objective 24.)	iii. Pencil and paper A number of sets of objects with different numbers of members	iii. **PROCEDURE:** **Sets:** Place two sets of objects before the child, each set containing a different number of objects. Say: "Pair the elements in these sets to find the difference." Ask: "Are they the same in number? What is the difference?" (These questions may be omitted.) Say: "Write the number sentence." Repeat, using other pairs of sets, to give the required number of test items.
	Pencil and paper A box of rods.	**Rods:** Place before the child two unequal rods. State that white is the unit. Say: "Place these rods side by side, to find the difference." Ask: "Are they the same? What is the difference?" (These questions may be omitted.) Say: "Write the number sentence." Repeat, using other pairs of rods, to give the required number of test items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		**Acceptable Response:** The child performs the action and writes the number sentence correctly, using the form $10 - 9 = 1$. **Note:** If the child is uncertain, say "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
iv. Records the deriving of subtraction facts from addition facts. (Recording of Objective 26.)	iv. Pencil and paper Sets of objects.	iv. **PROCEDURE:** **Sets** Place before the child a set of objects. Say: "Separate this set into two subsets." "Write the number sentence." ** "Now write as many other number sentences about this as you can think of, both addition and subtraction." Repeat, to give the required number of test items, starting on each occasion with a set containing a different number of members.
	Pencil and paper A box of rods.	**Rods** Place before the child one of the longer rods, stating that white is the unit.

** The test proper begins here.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Say: "Make a pattern, with two rods in the second line." "Write the number sentence." "Now write as many other number sentences from this pattern as you can think of, both addition and subtraction." Repeat, to give the required number of test items, using other rods and patterns. **Acceptable Response:** The child performs the action and makes an initial recording in the form 7 = 5 + 2. He follows this with other number sentences in the form: 7 = 2 + 5 7 − 5 = 2 2 = 7 − 5 5 + 2 = 7 7 − 2 = 5 7 − 5 − 2 = 0 2 + 5 = 7 5 = 7 − 2 7 − 2 − 5 = 0 The minimum requirement for success is two addition and two subtraction forms.
v. Records the combining of equivalent sets (multiplication). (Recording of Objective 27).	v. Pencil and paper A collection of objects from which equivalent sets can be made.	v. **PROCEDURE:** **Sets** Place a number of equivalent sets before the child, (for example, four sets, each with two members). Say: "Combine these sets to make a new set." "Write the number sentence." Repeat, to give the required number of test items, using other groups of equivalent sets.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)	Pencil and paper A box of rods.	**Rods** Place before the child several rods of the same colour. Say: "Place these end-to-end and measure them." "Write the number sentence." Repeat, to give the required number of test items, using other trains of rods. **Acceptable Response:** The child performs the action and writes the number sentence correctly, using the form $4 \times 2 = 8$ (meaning four twos equal eight) If the child responds using a repeated addition form, ask: "Can you do it another way?" **Note:** If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
vi. Records the finding of halves. (Recording of Objective 28.)	vi. Pencil and paper A collection of objects.	vi. **PROCEDURE:** **Sets** Place before the child a set of objects with an even number of members. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Say: "Separate this set into two subsets of the same number each." Ask: "What part (fraction) of the set is this?" (indicating one subset). Say: "Write the number sentence." or "Write the number sentence about that fraction." Repeat, to give the required number of test items, using other sets with an even number of members.
	Pencil and paper A box of rods.	**Rods** Place before the child a rod representing an even number, stating that white is the unit. Say: "Make a two-rod train for this rod." Ask: "What part (fraction) of the train is this rod?" (indicating one of the train rods). Say: "Write the number sentence." or "Write the number sentence about that fraction." Repeat, to give the required number of test items, using other rods representing even numbers. **Acceptable Response:** The child performs the action and writes the number sentence correctly in the form $4 = \frac{1}{2} \times 8$ or $\frac{1}{2} \times 8 = 4$

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Note: If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
vii. Records the finding of thirds, quarters, fifths . . . (Recording of Objective 30.)	vii. Pencil and paper A collection of objects A box of rods.	vii. **PROCEDURE:** **Thirds** Place before the child a set of objects, the number of which is divisible by three, or a rod (or rods) representing a number divisible by three (white being the unit). Say: "Separate this set into three subsets each with the same number" (if working with sets) or "Make a three-rod train for this rod" (if working with rods). Ask: "What part (fraction) is this?" (indicating a subset, or a train rod). Say: "Write a number sentence." Repeat, to give the required number of test items, using other appropriate sets or rods. **Acceptable Response:** The child performs the action and writes the number sentence correctly, in the form $3 = \frac{1}{3} \times 9$ or $\frac{1}{3} \times 9 = 3$

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		**Note:** If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
	Pencil and paper	**Quarters, fifths, . . . ,**
	A collection of objects	The procedure outlined for thirds is adapted for other fractions.
	A box of rods.	Place before the child sets of objects or selected rods for numbers divisible by four, five, . . .
		Request the child to partition the set into four, five, . . . , parts, or to make for the selected rod(s) a train of four, five, . . . rods.
		Indicate one of the subsets, or one of the train-rods, and ask what fraction it represents.
		Ask the child to write the number sentence.
		Repeat for each fraction, to give the required number of test items for each.
		Acceptable Response:
		The child performs the action and writes the number sentence correctly in the form:
		$\frac{1}{4} \times 8 = 2$ or $2 = \frac{1}{4} \times 8$
		$\frac{1}{5} \times 10 = 2$ or $2 = \frac{1}{5} \times 10$
		$\frac{1}{6} \times 6 = 1$ or $1 = \frac{1}{6} \times 6$
		. . . .

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued) **Note:** Items viii, ix and x relate to forms of division. The division sign is not used in the early stages. Answers to division questions are recorded in the form of multiplication number sentences.		If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.
viii. Records the partitioning of a set for sharing. (Recording of Objective 31.)	viii. Pencil and paper A collection of objects.	viii. **PROCEDURE:** **Set** Place before the child a set of objects the number of members being divisible by a selected number, for example, by six. Say: "Share these objects among six people; find out what each person's share will be." "Now write the number sentence." Repeat, to give the required number of test items, using other appropriate sets.
	Pencil and paper A box of rods.	**Rods** Place before the child a rod or rods representing a number divisible by a selected number, for example, by six.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		Say: "Share this number among six people; find out what each person's share will be." "Now write the number sentence." Repeat, to give the required number of test items, using other appropriate rods. **Acceptable Response:** The child performs the appropriate action, partitioning the set or making a train, and records his findings in a number sentence in the following form: $12 = 6 \times 2$ or $6 \times 2 = 12$ to indicate each "share" would consist of *two* things ("Twelve is six twos." or "There are six twos in twelve.") **Note:** • If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached. • The child may find it helpful to write the number sentence first as $12 = 6 \times \square$ and then fill in the frame. • If the child writes $\frac{1}{6} \times 12 = 2$, indicating that each share is a sixth of the set, and that this is two, he is not incorrect (in fact he shows a mature understanding). Say: "Can you write it another way?"

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		
ix. Records the partitioning of a set to find out how many equivalent sub-sets there are (division) (Recording of Objective 32.)	ix. Pencil and paper Sets of objects.	ix. **PROCEDURE:** **Sets** †† Place before the child a set of objects, the number of members being divisible by a selected number (three). Say: "Separate this set into subsets of three, to find out how many there are." "Write the number sentence." Repeat, to give the required number of test items, using sets with the number of members being divisible by other selected numbers.
	Pencil and paper A box of rods.	**Rods** †† Place before the child a rod, or rods, representing a number divisible by a selected number (three). State that white is the unit. Say: "Make a train to find out how many threes are in that number." "Write the number sentence." Repeat, to give the required number of test items, using rods representing numbers divisible by other selected numbers. **Acceptable Response:** The child performs the action and writes the number sentence in the form: 4 x 3 = 12 or 12 = 4 x 3

†† The number may be varied.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)		to indicate that there are four threes in twelve, or that twelve consists of four threes. **Note:** • If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If he is then successful, an intermediate stage has been reached. • The child many find it helpful to write the number sentence first as $12 = \square \times 3$ and then fill in the frame.
x. Records the removal of equivalent subsets. (Recording of Objective 33.)	x. Pencil and paper Sets of objects.	x. **PROCEDURE:** **Sets** Place before the child a set of objects the number being such that the set can be partitioned into equivalent subsets. For example, a set whose number is divisible †† by four would be suitable; the procedure set out below is based on such a set. Say: "Remove four objects; remove another four; continue removing fours until none is left." Ask: "How many fours did (could) you remove?" (This question may be omitted.) Say: "Write a number sentence which tells how many fours in that number." Repeat, to give the required number of test items, selecting other appropriate numbers of objects.

†† The number may be varied.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
34. (continued)	Pencil and paper A box of rods.	**Rods** Place before the child a rod or line of rods representing a number for which a train can be made. (Indicate that white is the unit.) For example, rods for which a †† crimson train can be made would be suitable; the procedure set out below is based on such a line of rods. Say: "Make a crimson train for this. Tell me which number each train-rod represents. Remove a four, remove another four; continue removing fours until none is left." Ask: "How many fours did (could) you remove?" (This question may be omitted.) Say: "Write a number sentence which tells how many fours in that number." Repeat, to give the required number of test items, selecting other appropriate rods and numbers. **Acceptable Response:** The child carries out the actions and writes the number sentence correctly, in the form: 3 x 4 = 12 which indicates that there are *three* fours in twelve. **Note:** If the child is uncertain, say: "Tell me the number sentence first. Now write it down." If the child is then successful, an intermediate stage has been reached.

†† The colour may be varied.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
35. Understands the value of the written symbols representing numbers beyond ten, to ninety-nine. (Numeration)	i. A collection of objects consisting of ten bundles of ten, and ten single objects e.g. the bundles may consist of used matches held together with rubber bands.	**Using Sets of Objects:** i. **Recording given numbers** **PROCEDURE:** Place before the child three bundles of ten and four single objects. Ensure that the child knows that there are ten in each bundle. Ask: "How many 'things' are there?" Say: "Write that number." Ask: "Why did you write 3?" "Why did you write 4?" Repeat with other numbers of bundles and single objects, to give the required number of test items. **Acceptable Response:** The child states the number correctly, "thirty-four" (not "three tens and four") and writes the numeral 34. He states in his own words that the 3 refers to the three bundles of ten, and the 4 refers to the four single objects.
	ii. Cards each with a numeral of value greater than ten (to 99) Objects as in 35 i. above.	ii. **Interpreting given numerals** **PROCEDURE:** Show the child a card with a numeral, for example 34.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
35. (continued)		Say: "Make this number." or "Make a set with this number." Ask: "How many things did you use?" "Why did you get three bundles of ten?" "How many is that?" "How did you know to get four 'singles'?" Repeat, showing other numeral cards, to make the required number of test items. **Acceptable Response:** The child makes the required number, using tens and units, and explains the reasons for his selection. For example, with the card for 34, he states in his own words that the first numeral, 3, represents the three bundles of ten (and that this is thirty), and the last numeral, 4, represents four units. **Using Rods**
	i. A box of rods.	i. **Recording given numbers** **PROCEDURE:** Place before the child three orange rods and a crimson rod. Indicate that white is the unit. Ask: "What number is that?" or "What number do these rods represent?" Say: "Write the number." Ask: "Why did you write 3?" "Why did you write 4?" (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
35. (continued)		Repeat with other rods, to make the required number of test items. **Acceptable Response:** The child states the number correctly, for example, "thirty-four" (not "three tens and four") and writes the numeral 34. He states in his own words that the 3 refers to the three tens (the orange rods), and the 4 refers to the four units (crimson rod).
	ii. Cards each with a numeral of value greater than ten. (to 99).	ii. **Interpreting given numerals.** **PROCEDURE:** Show the child a card with a numeral, for example, 34. Indicate that white is the unit. Say: "Make this number with rods." Ask: "What number have you made with the rods?" "Why did you get three *orange* rods? What number is that? Why did you get a *crimson* rod?" Repeat, showing other numeral cards, to make the required number of test items. **Acceptable Response:** The child makes the required number, using orange rods with another rod. He states in his own words that, for example, the first numeral, 3, represents the three orange rods, which is thirty, and that the last numeral, 4, represents the crimson rod, which is four units.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
36. **Knows how to write the numerals for given numbers beyond ten, to 99 (Notation).**	Pencil and paper.	**PROCEDURE:** Dictate to the child ten numbers one at a time: Seventeen, twenty-four, thirty-two, forty-six, fifty-one, sixty-three, seventy-eight, eighty-nine, ninety, twelve. Say first: "Write (numerals for) these numbers." **Acceptable Response:** The child writes 17, 24, 32, 46, 51, 63, 78, 89, 90, 12, correctly. The child must succeed in all ten items. It is not necessary that the child indicate place-value by writing in vertical columns.
37. **Uses memorised number facts in number sentences.**	Each set of test items should be presented at the appropriate stage of the learning process. These tests of memorisation are to be given only after sufficient experience of written work using concrete material. Cards, or Duplicated sheets, or Chalkboard copy, each showing a set of five examples in one of the categories set out below. Pencil Blank paper (if using chalkboard copy).	**PROCEDURE:** One set of examples only should be presented at a time, and corrected before proceeding. For each category, one suitable set of five examples is shown. If a further set is required the teacher should devise five more examples similar to those shown. In some cases it may be necessary to repeat examples to obtain the required number in the second set. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)		Show the child the set of examples. Explain whether the answer is to be inserted, or the whole number sentence copied. Concrete material is *not* to be used for this Objective. **Acceptable Response:** For each category, the child should answer correctly *five examples out of five* (i.e. none wrong), or at least *eight out of ten* (i.e. only two wrong allowed). In a few cases (e.g. for testing quarters, within the range of ten) it will not be possible to devise sufficient different test questions. The teacher may repeat some of the questions. Alternatively, a reduced number may be presented. In such cases the child should answer correctly *all* the examples which are given. **Note:** After written tests, interview-type follow-up may reveal further information about a child's responses.
	Addition categories Total to 10. No Zero	**Set of examples for each category listed:**
	1. Two addends, larger first, frame for total last.	1. 4+2=☐ 6+3=☐ 7+1=☐ 5+4=☐ 6+2=☐
	2. Two addends, smaller first, frame for total last.	2. 3+6=☐ 2+5=☐ 1+8=☐ 4+6=☐ 2+4=☐
	3. Three addends, frame for total last.	3. 2+4+1=☐ 1+2+3=☐ 6+2+1=☐ 3+1+3=☐ 4+2+3=☐

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	4. Frame for total first; two addends, larger first.	4. ☐=6+3 ☐=6+2 ☐=9+1 ☐=4+3 ☐=5+4
	5. Frame for total first; two addends, smaller first.	5. ☐=1+6 ☐=2+3 ☐=3+4 ☐=4+5 ☐=3+7
	6. Frame for total first; three addends.	6. ☐=3+5+1 ☐=2+4+2 ☐=1+8+1 ☐=2+2+3 ☐=1+4+5
	7. Two addends, frame for second; total last.	7. 4+☐=7 5+☐=8 9+☐=10 2+☐=5 3+☐=7
	8. Two addends, frame for first; total last.	8. ☐+2=6 ☐+1=8 ☐+4=9 ☐+3=6 ☐+2=10
	9. Three addends, frame for third; total last.	9. 2+4+☐=9 1+2+☐=6 5+3+☐=10 3+1+☐=8 2+6+☐=9
	10. Two addends equal two addends, frame for last.	10. 6+1=3+☐ 3+2=4+☐ 5+4=7+☐ 4+2=1+☐ 3+5=5+☐
	Total to 10 (including zero).	
	11. Zero as one addend, occuring second, in frame; total last.	11. 8+☐=8 7+☐=7 5+☐=6 3+☐=3 9+☐=10 (includes two examples from category 1, to prevent perseveration)

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	Total to 20 (no zero).					
	12. Frame for total last; two addends each less than ten, larger first.	12. 9+3= ☐	6+5= ☐	9+7= ☐	8+5= ☐	7+4= ☐
	13. Frame for total last; two addends each less than ten, smaller first.	13. 5+8= ☐	4+7= ☐	3+9= ☐	5+9= ☐	6+8= ☐
	14. Frame for total last; two addends, one over ten, larger first	14. 12+4= ☐	13+5= ☐	17+2= ☐	16+4= ☐	11+8= ☐
	15. Frame for total last; two addends, one over ten, smaller first.	15. 5+13= ☐	2+17= ☐	6+11= ☐	5+14 = ☐	6+12= ☐
	16. Frame for total last; three addends, each below ten.	16. 5+7+2= ☐	6+9+3= ☐	7+7+1= ☐	2+5+9= ☐	8+1+8= ☐
	17. Frame for total last; three addends, one over ten.	17. 2+4+12= ☐	13+3+3= ☐	1+15+2= ☐	11+2+6= ☐	3+5+12= ☐
	18. Frame for total first; two addends below ten, larger first.	18. ☐ =7+4	☐ =9+3	☐ =8+6	☐ =9+7	☐ =7+6
	19. Frame for total first; two addends below ten, smaller first.	19. ☐ =5+9	☐ =3+8	☐ =6+8	☐ =4+7	☐ =7+8

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	20. Frame for total first; two addends, one over ten; larger first.	20. ☐=13+3	☐=15+2	☐=11+7	☐=13+5	☐=12+8
	21. Frame for total first; two addends one over ten; smaller first.	21. ☐=4+15	☐=3+16	☐=5+12	☐=9+11	☐=1+14
	22. Frame for total first; three addends all below ten.	22. ☐=2+6+5	☐=3+9+4	☐=8+6+5	☐=3+8+7	☐=7+5+8
	23. Frame for total first; three addends, one over ten.	23. ☐=3+14+2	☐=2+16+2	☐=15+3+1	☐=4+3+12	☐=4+2+12
	24. Total last; two addends below ten; frame for second.	24. 8+☐=12	9+☐=15	9+☐=18	7+☐=13	8+☐=16
	25. Total last; two addends below ten; frame for first.	25. ☐+9=14	☐+6=11	☐+7=15	☐+9=18	☐+8=17
	26. Total last; two addends, one over ten; frame for larger number in middle.	26. 2+☐=18	3+☐=15	6+☐=20	3+☐=19	1+☐=17
	27. Total last; two addends, one over ten; frame for smaller number first.	27. ☐+14=19	☐+15=16	☐+13=17	☐+12=15	☐+19=20

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	28. Total last; three addends below ten, frame for any.	28. 6+☐+3=15 7+2+☐=16 ☐+5+8=20 8+☐+1=18 ☐+5+5=15
	29. Total last; three addends, one over ten; frame for one of the smaller addends.	29. 3+12+☐=20 2+11+☐=18 ☐+15+2=19 14+2+☐=17 ☐+3+14=19
	Total to 20, zero included.	
	30. Total last; zero as one addend; frame for zero.	30. 19+☐=19 18+☐=18 13+☐=15 12+☐=12 17+☐=20 (includes two examples from category 14, to prevent perseveration)
	31. Two addends equal two addends; frame for last.	31. 8+7=9+☐ 7+6=10+☐ 12+8=20+☐ 9+8=8+☐ 6+5=4+☐
	Subtraction	
	Note: In the number sentence 6 – 4 = 2 6 is called the minuend 4 is called the subtrahend 2 is called the difference	
	Minuend to 10. No zero.	
	1. Difference frame last; subtrahend, 1 or 2.	1. 6–1=☐ 7–2=☐ 8–2=☐ 5–1=☐ 10–2=☐

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	2. Difference frame last; subtrahend larger than difference.	2. 9–6= ☐ 10–6= ☐ 7–4= ☐ 8–5= ☐ 9–5= ☐
	3. Answer frame last; two subtrahends.	3. 9–2–1= ☐ 10–5–3= ☐ 8–4–2= ☐ 7–2–4= ☐ 10–1–6= ☐
	4. Frame for difference first; subtrahend smaller than difference.	4. ☐ =9–1 ☐ =10–3 ☐ =6–2 ☐ =8–3 ☐ =9–4
	5. Frame for difference first; subtrahend greater than difference.	5. ☐ =10–7 ☐ =8–6 ☐ =9–5 ☐ =7–5 ☐ =6–4
	6. Frame for answer first; two subtrahends.	6. ☐ =7–2–1 ☐ =10–3–4 ☐ =9–4–2 ☐ =8–1–6 ☐ =9–2–5
	Minuend to 10. Zero included.	
	7. Difference frame last; zero is subtrahend.	7. 6–0= ☐ 7–0= ☐ 10–0= ☐ 5–0= ☐ 1–0= ☐
	8. Difference frame last; zero is difference in frame.	8. 6–6= ☐ 10–10= ☐ 7–6= ☐ 8–8= ☐ 9–1= ☐ (contains two examples from categories 1 and 2 to prevent perseveration)
	9. Difference last, frame for subtrahend; subtrahend smaller than difference.	9. 6– ☐ =4 10– ☐ =8 7– ☐ =6 9– ☐ =5 8– ☐ =5

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	10. Difference last, frame for subtrahend; subtrahend is greater than difference.	10. 9– ☐ =2 8– ☐ =2 10– ☐ =3 7– ☐ =2 8– ☐ =3
	11. Difference last; difference is zero; frame for subtrahend.	11. 6– ☐ =0 10– ☐ =0 5– ☐ =0 9– ☐ =0 2– ☐ =0
	12. Difference last, frame for subtrahend. Subtrahend is zero.	12. 6– ☐ =6 10– ☐ =10 6– ☐ =5 8– ☐ =3 9– ☐ =9 (contains two examples from categories 1 and 2 to prevent perseveration)
	Minuend to 20. No zero.	
	13. Frame for difference last; subtrahend is 1 or 2.	13. 15–1= ☐ 17–1= ☐ 16–1= ☐ 18–2= ☐ 13–2= ☐
	14. Frame for difference last; subtrahend is greater than difference but under 10.	14. 15–9= ☐ 13–7= ☐ 14–8= ☐ 12–7= ☐ 17–9= ☐
	15. Frame for difference last; subtrahend is larger than 10.	15. 15–12= ☐ 18–14= ☐ 17–14= ☐ 20–15= ☐ 19–11= ☐
	16. Frame for answer last; two subtrahends both under 10.	16. 16–2–3= ☐ 17–1–4= ☐ 12–2–3= ☐ 20–8–7= ☐ 10–5–4= ☐
	17. Frame for answer last; two subtrahends, one over 10.	17. 16–12–2= ☐ 14–11–1= ☐ 20–2–14= ☐ 13–1–11= ☐ 19–13–5= ☐

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	Minuend to 20. Zero included.	
	18. Frame for difference last; zero is subtrahend.	18. 16–0= ☐ 17–0= ☐ 20–0= ☐ 13–0= ☐ 11–0= ☐
	19. Frame for difference last; zero is difference in frame.	19. 16–16= ☐ 18–18= ☐ 17–2= ☐ 15–1= ☐ 17–17= ☐ (contains two examples from category 13 to prevent perseveration)
	20. Frame for difference first; subtrahend is 1 or 2.	20. ☐ =15–1 ☐ =13–2 ☐ =17–1 ☐ =18–2 ☐ =19–1
	21. Frame for difference first; subtrahend is greater than difference, but under 10.	21. ☐ =15–9 ☐ =14–8 ☐ =13–7 ☐ =12–8 ☐ =11–7
	22. Frame for difference first; subtrahend is greater than 10.	22. ☐ =15–12 ☐ =17–13 ☐ =19–11 ☐ =20–14 ☐ =16–12
	23. Frame for answer first; two subtrahends, both under 10.	23. ☐ =16–2–3 ☐ =18–5–4 ☐ =12–2–3 ☐ =20–7–6 ☐ =18–2–9
	24. Frame for answer first; two subtrahends, one over 10.	24. ☐ =16–12–2 ☐ =18–15–1 ☐ =17–2–14 ☐ =18–3–12 ☐ =20–4–14
	25. Difference last; frame for subtrahend; subtrahend under 10.	25. 16– ☐ =14 17– ☐ =13 18– ☐ =9 14– ☐ =7 20– ☐ =11

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	26. Difference last; frame for subtrahend; subtrahend over 10.	26. 16– ☐ =2	18– ☐ =1	20– ☐ =4	12– ☐ =1	17– ☐ =2
	27. Difference last; frame for subtrahend; difference is zero.	27. 16– ☐ =0	17– ☐ =0	13– ☐ =0	20– ☐ =0	11– ☐ =0
	28. Difference last; frame for subtrahend; subtrahend is zero.	28. 16– ☐ =16	18– ☐ =18	13– ☐ =12	19– ☐ =18	12– ☐ =12
	Multiplication Product to 10. Two factors, no zero.					
	1. Factors first; frame for product.	1. 2x3= ☐	4x2= ☐	3x3= ☐	6x1= ☐	5x2= ☐
	2. Product first; frame for product.	2. ☐ =2x3	☐ =3x3	☐ =7x1	☐ =2x4	☐ =5x2
	3. Product last; frame for first factor. (Type: How many threes in six?)	3. ☐ x3=6	☐ x2=8	☐ x5=10	☐ x4=8	☐ x6=6

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	4. Product last; frame for second factor. (Type: Two "whats" are six?)	4. 2x ☐ =6	3x ☐ =9	5x ☐ =10	4x ☐ =4	3x ☐ =6
	5. Product first; frame for first factor. (Type: Six is how many threes?)	5. 6= ☐ x3	8= ☐ x4	10= ☐ x5	9= ☐ x3	7= ☐ x1
	6. Product first; frame for second factor. (Type: Six is two of what?)	6. 6=2x ☐	8=4x ☐	9=3x ☐	7=7x ☐	10=5x ☐
	Product to 20. Two factors. No zero. All factors under 10.					
	7. Product last; frame for product.	7. 5x3= ☐	4x5= ☐	8x2= ☐	2x9= ☐	4x4= ☐
	8. Product first; frame for product.	8. ☐ =5x3	☐ =2x8	☐ =7x2	☐ =3x4	☐ =6x3
	9. Product last; frame for first factor. (Type: How many threes in fifteen?)	9. ☐ x3=15	☐ x4=16	☐ x2=12	☐ x6=18	☐ x4=12
	10. Product last; frame for second factor. (Type: Five "whats" are fifteen?)	10. 5x ☐ =15	4x ☐ =12	3x ☐ =18	4x ☐ =16	2x ☐ =14

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	11. Product first; frame for first factor. (Type: Fifteen, how many threes?)	11. 15= ☐ x3	18= ☐ x6	14= ☐ x7	20= ☐ x5	12= ☐ x2
	12. Product first; frame for second factor. (Type: Fifteen equals five of what?) (Used in "Share 15 lollies among 5 children.")	12. 15=5x ☐	20=4x ☐	12=3x ☐	18=3x ☐	16=4x ☐
	Fractions. Range to 10.					
	1. Halves; frame last for smaller number.	1. $\frac{1}{2}$x10= ☐	$\frac{1}{2}$x8= ☐	$\frac{1}{2}$x4= ☐	$\frac{1}{2}$x6= ☐	$\frac{1}{2}$x2= ☐
	2. Halves; frame last for larger number.	2. 5=$\frac{1}{2}$x ☐	4=$\frac{1}{2}$x ☐	2=$\frac{1}{2}$x ☐	1=$\frac{1}{2}$x ☐	3=$\frac{1}{2}$x ☐
	3. Halves; frame in middle for larger number.	3. $\frac{1}{2}$x ☐ =5	$\frac{1}{2}$x ☐ =3	$\frac{1}{2}$x ☐ =4	$\frac{1}{2}$x ☐ =1	$\frac{1}{2}$x ☐ =2
	4. Halves; frame first for smaller number.	4. ☐ =$\frac{1}{2}$x10	☐ =$\frac{1}{2}$x4	☐ =$\frac{1}{2}$x8	☐ =$\frac{1}{2}$x6	☐ =$\frac{1}{2}$x2

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	5. Quarters; frame last for smaller number.	5. $\frac{1}{4}x8=\square$ $\frac{1}{4}x4=\square$ $\frac{1}{4}x8=\square$ $\frac{1}{4}x4=\square$ $\frac{1}{4}x8=\square$ (Repetition of examples is necessary to make up number.)
	6. Quarters; frame last for larger number.	6. $2=\frac{1}{4}x\square$ $1=\frac{1}{4}x\square$ $2=\frac{1}{4}x\square$ $1=\frac{1}{4}x\square$ $2=\frac{1}{4}x\square$ (see note above)
	7. Quarters; frame in middle for larger number	7. $\frac{1}{4}x\square=2$ $\frac{1}{4}x\square=1$ $\frac{1}{4}x\square=2$ $\frac{1}{4}x\square=1$ $\frac{1}{4}x\square=2$ (see note above)
	8. Quarters; frame first for smaller number.	8. $\square=\frac{1}{4}x8$ $\square=\frac{1}{4}x4$ $\square=\frac{1}{4}x8$ $\square=\frac{1}{4}x4$ $\square=\frac{1}{4}x8$ (see note above)
	9. Thirds; frame first for smaller number.	9. $\frac{1}{3}x9=\square$ $\frac{1}{3}x6=\square$ $\frac{1}{3}x3=\square$ $\frac{1}{3}x6=\square$ $\frac{1}{3}x9=\square$ (see note above)
	10. Thirds; frame last for larger number.	10. $3=\frac{1}{3}x\square$ $2=\frac{1}{3}x\square$ $1=\frac{1}{3}x\square$ $3=\frac{1}{3}x\square$ $2=\frac{1}{3}x\square$ (see note above)
	11. Thirds; frame in middle for larger number.	11. $\frac{1}{3}x\square=3$ $\frac{1}{3}x\square=2$ $\frac{1}{3}x\square=1$ $\frac{1}{3}x\square=2$ $\frac{1}{3}x\square=3$ (see note above)
	12. Thirds; frame first for smaller number.	12. $\square=\frac{1}{3}x9$ $\square=\frac{1}{3}x3$ $\square=\frac{1}{3}x9$ $\square=\frac{1}{3}x6$ $\square=\frac{1}{3}x3$ (see note above)
	Note: Similar tests, if desired, may be devised for a fifth of, a sixth of, a seventh of, an eighth of, a ninth of, and a tenth of, based on:	

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
37. (continued)	$\frac{1}{5}$ x 10 = 2 $\frac{1}{6}$ x 6 = 1 $\frac{1}{7}$ x 7 = 1 $\frac{1}{8}$ x 8 = 1 $\frac{1}{9}$ x 9 = 1 $\frac{1}{10}$ x 10 = 1 Range to 20.	
	13. Halves; frame last for smaller number.	13. $\frac{1}{2}$x20= ☐ $\frac{1}{2}$x10= ☐ $\frac{1}{2}$x18= ☐ $\frac{1}{2}$x12= ☐ $\frac{1}{2}$x16= ☐
	14. Halves; frame last for larger number.	14. 10=$\frac{1}{2}$x ☐ 9=$\frac{1}{2}$x ☐ 7=$\frac{1}{2}$x ☐ 8=$\frac{1}{2}$x ☐ 6=$\frac{1}{2}$x ☐
	15. Halves; frame in middle for larger number.	15. $\frac{1}{2}$x ☐ =10 $\frac{1}{2}$x ☐ =8 $\frac{1}{2}$x ☐ =5 $\frac{1}{2}$x ☐ =7 $\frac{1}{2}$x ☐ =9
	16. Halves; frame first for smaller number.	16. ☐ =$\frac{1}{2}$x20 ☐ =$\frac{1}{2}$x14 ☐ =$\frac{1}{2}$x18 ☐ =$\frac{1}{2}$x12 ☐ =$\frac{1}{2}$x10
	17. Quarters; frame last for smaller number.	17. $\frac{1}{4}$x16= ☐ $\frac{1}{4}$x12= ☐ $\frac{1}{4}$x20= ☐ $\frac{1}{4}$x16= ☐ $\frac{1}{4}$x20= ☐ (Repetition of examples is necessary to make up number)
	18. Quarters; frame last for larger number.	18. 4=$\frac{1}{4}$x ☐ 3=$\frac{1}{4}$x ☐ 5=$\frac{1}{4}$x ☐ 4=$\frac{1}{4}$x ☐ 5=$\frac{1}{4}$x ☐ (see note above)

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.				
37. (continued)	19. Quarters; frame in middle for larger number.	19. $\frac{1}{4}$ x ☐ =4	$\frac{1}{4}$ x ☐ =3	$\frac{1}{4}$ x ☐ =5 (see note above)	$\frac{1}{4}$ x ☐ =4	$\frac{1}{4}$ x ☐ =3
	20. Quarters; frame first for smaller number.	20. ☐ =$\frac{1}{4}$ x16	☐ =$\frac{1}{4}$ x12	☐ =$\frac{1}{4}$ x16 (see note above)	☐ =$\frac{1}{4}$ x20	☐ =$\frac{1}{4}$ x16
	21. Thirds; frame last for smaller number.	21. $\frac{1}{3}$ x15= ☐	$\frac{1}{3}$ x12= ☐	$\frac{1}{3}$ x18= ☐ (see note above)	$\frac{1}{3}$ x15= ☐	$\frac{1}{3}$ x18= ☐
	22. Thirds; frame last for larger number.	22. 5=$\frac{1}{3}$ x ☐	6=$\frac{1}{3}$ x ☐	5=$\frac{1}{3}$ x ☐ (see note above)	4=$\frac{1}{3}$ x ☐	6=$\frac{1}{3}$ x ☐
	23. Thirds; frame in middle for larger number.	23. $\frac{1}{3}$ x ☐ =5	$\frac{1}{3}$ x ☐ =6	$\frac{1}{3}$ x ☐ =4 (see note above)	$\frac{1}{3}$ x ☐ =5	$\frac{1}{3}$ x ☐ =6
	24. Thirds; frame first for smaller number.	24. ☐ =$\frac{1}{3}$ x15	☐ =$\frac{1}{3}$ x18	☐ =$\frac{1}{3}$ x12 (see note above)	☐ =$\frac{1}{3}$ x15	☐ =$\frac{1}{3}$ x18
	Note: Similar tests, if desired, may be devised for a fifth of, a sixth of, a seventh of, an eighth of, a ninth of, and a tenth of, based on: $\frac{1}{5}$ x 20 = 4 $\frac{1}{6}$ x 18 = 3 $\frac{1}{7}$ x 14 = 2 $\frac{1}{8}$ x 16 = 2 $\frac{1}{9}$ x 18 = 2 $\frac{1}{10}$ x 20 = 2					

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. Applies the knowledge gained and the number facts learnt to composing environmental narratives for the operations of (a) addition, (b) subtraction, (c) multiplication, (d) finding fractional parts and (e) division.	Concrete material with which to make structures representing number sentences.	
(a) Addition	(a) i. A collection of objects.	(a) i. **PROCEDURE**: Show the child two sets of objects, then carry out the action of combining them to make a new set. For example, a set of five and a set of two may be pushed together to show a new set of seven. Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other structures, with actions, illustrating addition number sentences (two addends), to make the required number of test items. **Acceptable Response**: Using all the given numbers the child composes, and states orally, a narrative which shows that he applies his knowledge of addition to an environmental situation. For example: "I had five marbles. I won two more, then I had seven."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)	(a) ii. A box of rods.	(a) ii. **PROCEDURE:** Show the child a pattern in which two rods end-to-end are measured with a single rod, e.g. yellow and red measured with black, representing the number sentence 5 + 2 = 7. Say: "Tell me a story about that pattern." (a narrative, not a number sentence) Repeat using other patterns illustrating addition number sentences (two addends), to make the required number of test items. **Acceptable Response:** Using all the given numbers the child composes, and states orally, a narrative which shows that he applies his knowledge of addition to an environmental situation. For example: "My sister has five cents, my brother has two cents. So they have seven cents altogether."
	(a) iii. Cards, on each of which is one addition number sentence in the form: 5 + 2 = 7	(a) iii. **PROCEDURE:** Show the child one of the cards. Say: "Tell me a story about this number sentence." Repeat, using other cards, to give the required number of test items. **Acceptable Response:** Using all the given numbers the child composes, and states orally, a narrative which shows that he applies his knowledge of addition to an environmental situation. For example: "There are five flowers on this plant and two flowers on that. So that makes seven flowers."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued) (b) Subtraction (removal)	(b) i. A collection of objects.	(b) i. **PROCEDURE**: Using objects, show the child a structure, with actions, representing a number sentence, for example: $7 - 2 = 5$ (i.e. a subset of two is removed from a set of seven, leaving a subset of five.) Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other structures, with actions illustrating subtraction by removal, to give the required number of test items. **Acceptable Response**: Using all the numbers given, the child composes, and states orally, a narrative which shows that he applies his knowledge of "removal" subtraction to an environmental situation. For example: "Seven birds were on a tree. Two flew away. So five were left."
	(b) ii. A box of rods.	(b) ii. **PROCEDURE**: Show the child a rod structure in which a shorter rod is placed on top of another and the "gap" measured. For example, red on top of black, with yellow measuring the "gap", representing the number sentence $7 - 2 = 5$. Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other structures with actions illustrating subtraction by removal, to give the required number of test items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		**Acceptable Response:** Using all the numbers given, the child composes, and states orally, a narrative which shows that he applies his knowledge of "removal" subtraction to an environmental situation. For example: "Tony had seven apples. He gave two away. So he had five left."
	(b) iii. Cards, on each of which is one subtraction number sentence in the form: $7 - 2 = 5$	(b) iii. **PROCEDURE:** Show the child one of the cards. Say: "Tell me a story about this number sentence." Repeat, using other cards showing subtraction number sentences, to give the required number of test items. **Acceptable Response:** Using all the numbers given, the child composes, and states orally, a narrative which shows that he applies his knowledge of "removal" subtraction to an environmental situation. For example: "Mother made seven patty-cakes. She gave me two, so that left five."
(c) i. **Subtraction (comparing)**	(c) i. A collection of objects.	(c) i. **PROCEDURE:** Place two sets of objects before the child and then pair them thus: 0-0 (for $7 - 5 = 2$) 0-0 0-0 0-0 0-0 0 0 (the comparison aspect of subtraction)

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		Say: "Tell me a story about this." Repeat, using other structures, with actions illustrating subtraction by comparison, to give the required number of test items. **Acceptable Response:** Using all the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of "comparison" subtraction to an environmental situation. For example, "I am seven and May is five. I am two years older than May." (or, "The difference in our ages is two years.")
	(c) ii. A box of rods.	(c) ii. **PROCEDURE:** Show the child a black and a yellow rod side by side, ends level. Measure the difference with a red rod. Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other structures, with actions illustrating subtraction by comparison, to give the required number of test items. **Acceptable Response:** Using all the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of "comparison" subtraction to an environmental situation. For example, "I hit the bullseye seven times and Tom hit it five times. I scored two more than Tom." (or, "The difference between our scores is two.")

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)	(c) iii. Cards on each of which is a number statement in the form: "The difference between 7 and 5 is 2."	(c) iii. **PROCEDURE**: Show the child one of the cards (read it aloud if necessary). Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other cards, with statements illustrating subtraction by comparison, to give the required number of test items. **Acceptable Response**: Using all the given numbers, the child composes and states orally a narrative which shows that he applies his knowledge of "comparison" subtraction to an environmental situation. For example, "Dick slept seven hours and Harry slept five. Dick slept two hours longer than Harry."
(d) **Multiplication**	(d) i. A collection of objects.	(d) i. **PROCEDURE**: Place before the child three sets of objects each with four members. Push them together to make a new set. Say: "Tell me a story about that." (a narrative, not a number sentence) Repeat, using other arrangements, with actions, illustrating multiplication, to give the required number of test items. **Acceptable Response**: Using the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of multiplication to an environmental

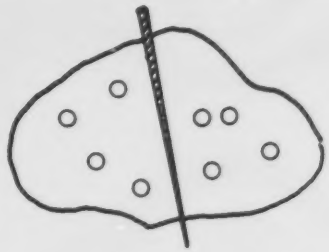
(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		situation. For example, "There are three boxes with four pencils in each, so there are twelve pencils." If the child composes a narrative in the repeated addition form, e.g. "There are four pencils in one box, four in another box and four pencils in another box; that is twelve pencils," say "Can you tell me that, in another way?" to ascertain whether the child can re-state the narrative in multiplication form.
	(d) ii. A box of rods.	(d) ii. **PROCEDURE**: Place before the child three crimson rods. Put them end-to-end and measure them with an orange and a red rod. Say: "Tell me a story about that pattern." (a narrative, not a number sentence) Repeat, using other train patterns, with actions, illustrating multiplication, to give the required number of test items. **Acceptable Response**: Using the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of multiplication to an environmental situation. For example, "There are three boxes with four pencils in each, so there are twelve pencils." **Note**: If the child composes a narrative in the repeated addition form, for example "There are four pencils in one box, four in another box and four in another box; that is twelve pencils", say "Can you tell me that in another way?" to ascertain whether the child can re-state the narrative in multiplication form.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)	(d) iii. Cards on each of which is one multiplication number sentence in the form: 3 x 4 = 12	(d) iii. **PROCEDURE**: Show the child one of the cards. Say: "Tell me a story about that." Repeat, using other cards, with sentences, illustrating multiplication, to give the required number of test items. **Acceptable Response**: Using the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of multiplication to an environmental situation. For example; "There are three cages with four birds in each, so there are twelve birds."
(e) **Fractions**	(e) i. A collection of objects. A number of "dividers" for partitioning sets. A "divider" may be a thin ruler, a pencil, a knitting needle or similar object.	(e) i. **With sets of objects** **Halves**: **PROCEDURE**: Place before the child a set which contains eight members. Using a "divider", partition the set so that there are four members on each side.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		

Say: "I have cut the set in half. Tell me a story about that." (a narrative, not a number sentence)

Repeat, halving other sets containing an even number of members, to give the required number of test items.

Acceptable Response:

Using the given numbers the child composes and states orally a narrative which shows that he applies a knowledge of halving to an environmental situation. For example: "I had eight marbles. I lost half of them, so I only had four left."

Note: The child bases his narrative on the number sentence derived from the model, rather than on the model itself.

Other Fractions:

PROCEDURE:

Adapt the procedures above, partitioning appropriate sets into three, or four, ... , subsets, to give examples involving thirds, quarters, ...

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		Repeat for each fraction, to give the required number of test items for each. **Acceptable Response:** Using the given numbers the child composes, and states orally, narratives which show that he applies a knowledge of thirds, quarters, ... , to an environmental situation.
	(e) ii. A box of rods.	(e) ii. **With rods.** **Halves:** **PROCEDURE:** Place before the child a brown rod. Place two crimson rods beside it. Say: "I have found half of that rod. Tell me a story about that." (a narrative, not a number sentence) Repeat, selecting other rods representing numbers which can be halved, to give the required number of test items. **Acceptable Response:** Using the given numbers the child composes and states orally, a narrative which shows that he applies a knowledge of halving to an environmental situation. For example: "I had eight lollies. I ate half of them, so I only had four left."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		**Other Fractions:** **PROCEDURE:** Adapt the above procedures outlined for halves, using appropriate rods, to give examples involving thirds, quarters, ... Repeat for each fraction, to give the required number of test items for each. **Acceptable Response:** Using the given numbers the child composes, and states orally, narratives which show that he applies a knowledge of thirds, quarters, ... , to an environmental situation.
	(e) iii. Cards on each of which is one fraction number sentence, in the form $\frac{1}{2} \times 12 = 6$	(e) iii. **With cards.** **Halves:** **PROCEDURE:** Show the child one of the cards. Say: "Tell me a story about that number sentence." Repeat, using other cards, to give the required number of test items. **Acceptable Response:** Using the given numbers the child composes, and states orally, a narrative which shows that he applies a knowledge of halving to an environmental situation. For example: "Tom had twelve pencils. He gave away half of them, so he only had six left."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		**Other Fractions:** **PROCEDURE:** Adapt the above procedure using appropriate cards, to give examples involving thirds, quarters, ... Repeat for each fraction, to give the required number of test items for each. Alternatively, include a variety of fractions in the set of test items. **Acceptable Response:** Using the given numbers the child composes, and states orally, narratives which show that he applies a knowledge of thirds, quarters, . . . , to an environmental situation.
(f) **Sharing** (division)	(f) i. A collection of objects.	(f) i. **PROCEDURE:** Place before the child a set of objects which contains twelve members. Divide the set into four equal "shares". Say: "I have 'shared out' this set of twelve into four shares. Tell me a story about that." (a narrative, not a number sentence) Repeat, using other appropriate sets and other numbers of "shares", to give the required number of test items. **Acceptable Response:** Using the given numbers the child composes, and states orally, a narrative which shows that he applies his knowledge of sharing to an environmental situation.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)		For example: "Mother shared twelve lollies amongst her four children; each received three lollies."
	(f) ii. A box of rods.	(f) ii. **PROCEDURE:** Place before the child an orange and a red rod, end-to-end. Measure this with four light-green rods. Say: "I have divided the orange and red into four equal 'shares'. Tell me a story about that." Repeat, using other appropriate rods, and other numbers of "shares", to give the required number of test items. **Acceptable Response:** Using the given numbers the child composes, and states orally, a narrative which shows that he applies his knowledge of sharing to an environmental situation. For example: "I shared twelve marbles amongst my four friends; each received three marbles."
	(f) iii. A number of cards on each of which is one sharing number sentence in the form $12 = 4 \times 3$ (four of three) (i.e. four "shares" of three each.)	(f) iii. **PROCEDURE:** Show the child one of the cards. Say: "Tell me a story about this sharing number sentence." Repeat, using other cards, to give the required number of test items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
38. (continued)	**Note**: The division sign is not used.	**Acceptable Response**: Using the given numbers, the child composes, and states orally, a narrative which shows that he applies his knowledge of sharing to an environmental situation. For example: "Father shared twelve cents amongst his four children; each received three cents."

Note: Division may also be used to answer questions of the type "How many twos in eight?" (which is answered "four twos in eight", and recorded in the form 4 x 2 = 8).

Narratives are in the form:

"If four people can go in a taxi, we will need two taxis for eight people."
"If four fish can live in one bowl, I will need two bowls for eight fish."

If desired, tests may be devised (using sets of objects, rods, and cards with number sentences) to test this understanding. The pattern of the "sharing" tests may be followed with appropriate adaptations. Examples are given below.

a. With sets. Show the child eight objects. Divide into four twos. Say: "I have found out how many twos in eight. Tell me a story about that."

b. With rods. Make a pattern with a train of red rods for the brown rod. Say: "I have found out how many twos in eight. Tell me a story about that."

c. With cards. Show the child a card with the number sentence 4 x 2 = 8. Say: "This tells us how many twos in eight. Tell me a story about that."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. Applies the knowledge gained and the number facts learned to answering questions contained in given narratives about the environment. This will involve situations embodying addition, subtraction, multiplication, finding fractional parts, and division.	Cards on each of which one narrative is written (to be read to or by the child) Numbers to be within the range • to ten • to twenty Note: Narratives may be written on the chalkboard or presented orally.	
(a) Addition.	(a) Cards, on each of which is written an addition narrative (with question).	(a) **Addition.** **PROCEDURE:** Show the child a card with an addition narrative in question form. For example: "Tom has five pencils and Mary has three. How many pencils altogether?" Repeat, with other addition narratives in question form, to give the required number of test items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. (continued)		**Acceptable Response:** The child should answer in one of the following forms (orally or in writing): "Eight." "Eight pencils." "There are eight pencils." **Note:** The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given.
(b) **Subtraction (removal).**	(b) Cards on each of which is written a "removal" subtraction narrative (with question).	(b) **Subtraction (removal).** **PROCEDURE:** Show the child a card with a removal subtraction narrative in question form. For example: "There were six birds in a tree, and four flew away. How many birds were left in the tree?" Repeat with other "removal" subtraction narratives in question form, to give the required number of test items. **Acceptable Response:** The child should answer in one of the following forms (orally or in writing): "Two." "Two birds." "There were two birds left."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. (continued)		**Note:** The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given.
(c) **Subtraction (comparison)**	(c) Cards, on each of which is written a "comparison" subtraction narrative (with question).	(c) **Subtraction (comparison).** **PROCEDURE:** Show the child a card with a "comparison" subtraction narrative in question form. For example: "Bill went to bed at six o'clock and Pam went at eight. How many hours later did Pam go to bed?" Repeat with other comparison subtraction narratives in question form to give the required number of test items. **Acceptable Response:** The child should answer in one of the following forms: "Two." "Two hours." "Pam went to bed two hours later." **Note:** The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. (continued)		
(d) **Multiplication.**	(d) Cards, on each of which is written a multiplication narrative (with question).	(d) **Multiplication.** **PROCEDURE:** Show the child a card with a multiplication narrative in question form. For example: "There are five houses in our street with two children in each. How many children altogether?" Repeat, with other multiplication narratives in question form, to give the required number of test items. **Acceptable Response:** The child should answer in one of the following forms (orally or in writing): "Ten." "Ten children." "There are ten children altogether." **Note:** The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given.
(e) **Fractions.**	(e) Cards, on each of which is written a fraction narrative (with question).	(e) **Fractions.** **PROCEDURE:** Show the child a card with a fraction narrative in question form. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. (continued)		For example: "My rose bush had eight roses on it. I picked a quarter of them. How many did I pick?" Repeat with other fraction narratives in question form, to give the required number of test items. **Acceptable Response:** The child should answer in one of the following forms (orally or in writing): "Two." "Two roses." "I picked two roses." **Note:** The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given above.
(f) **Sharing.**	(f) Cards, on each of which is written a "sharing" narrative (with question).	(f) **Sharing.** **PROCEDURE:** Show the child a card with a "sharing" narrative in question form. For example: "Dad had twelve cents to share equally among Peter, Wendy and John. How may cents did each child get?"

Continued

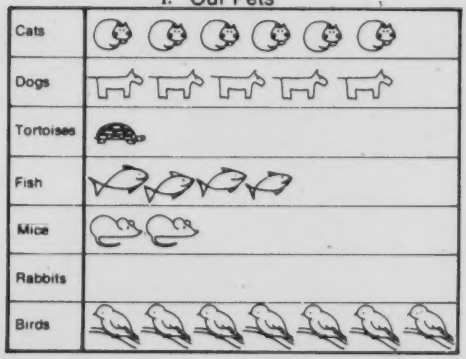
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
39. (continued)		Repeat with other "sharing" narratives in question form, to give the required number of test items. **Acceptable Response**: The child should answer in one of the following forms (orally or in writing): "Four." "Four cents." "They each got four cents." **Note**: The child may first write the number sentence using a frame, which he then fills in, but he must then answer in one of the forms given above. (The number sentence with frame, for the example above would be $12 = 3 \times \square$ or $3 \times \square = 12$.)
(g) **Division** (How many lots of?).	(g) If desired, the other form of division narratives may be presented. This is the form which asks, for example, "How many fours in eight?" Show the child a card with a narrative in question form. For example: "Mr. Brown in making toy carts with four wheels each. How many carts can he make if he has eight wheels?"	

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. **Applies the knowledge gained and the facts learned to representing every-day situations,** **(a) recording these in a variety of ways and** **(b) intrepreting the records.**	(a) Materials for graph-making including: pencil and paper graph paper (cm grid) strips of coloured paper gummed squares of coloured paper coloured pencils centicubes counters small toys (animals, cars etc.)	(a) **PROCEDURE:** (a) i. Place the materials before the child. Give the child the following information: "In our class of thirty children, fifteen children walk to school, five come by bus, five by car, four by bike and one by taxi." Say: "Choose any of the materials you like, and make a record of this information." (a) ii. Place the materials before the child. Give the child the following information: "In our class of 32 children, 4 children have birthdays in January, 3 were born in February, 2 in March, 6 in April, 0 in May, 2 in June, 0 in July, 5 in August, 7 in September, 0 in October, 1 in November and 2 in December." Say: "Choose any of the materials you like, and make a record of this information." (a) iii. Place the materials before the child. Give the child the following information: 182 Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)		"Tom threw the ball 10 metres, Wendy threw the ball 11 metres, Barry 9 metres, and John 4 metres." Say: "Choose any of the materials you like, and make a record of this information." (a) iv. Place the materials before the child. Give the child the following information: "On Monday the temperature was 24°, on Tuesday 28°, on Wednesday 32°, on Thursday 32°, and on Friday 20°." Say: "Choose any of the materials you like and make a record of this information." (a) v. Place the materials before the child. Give the child the following information: "For the Stewart House collection, our class brought $9, Mr. Jones' class brought $4, Mr. Smith's $8, Mrs. Brown's class brought $5, Miss Green's class $7 and the kindergarten brought $10." Say: "Choose any of the materials you like and make a record of this information." The above, i-v, constitute five test items. If ten are required, five further suitable narratives may be composed. **Acceptable Response:** The child must indicate that he can apply his knowledge of the recording of information in graphical form by: (Continued over)

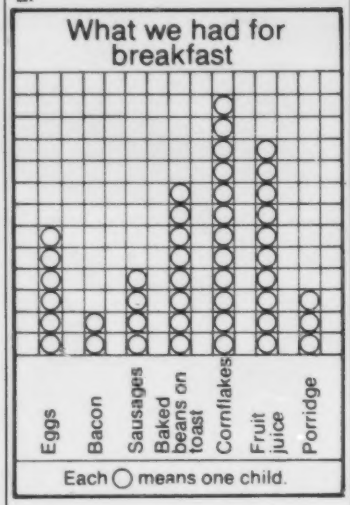
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)	(b) Cards (at least 30 cm x 30 cm in size) on each of which one of the following graphs is drawn and labelled as shown.	• use of a base line • the selection of a suitable unit • uniform spacing of the units • the correct numbers of units for each category. **Note:** The recording may be made by means of: • linked centicubes arranged standing upright, or lying flat • lines of counters, toys, paper squares, diagrams or symbols • coloured sections of graph paper. (b) **PROCEDURE**: (b) i. Place the card before the child. Ask: "Which is the most popular pet?" "Which is the least popular?" "How many pet dogs are there?" "How many more cats than mice?" "Can you tell me something else you have found out from this graph?"

i. Our Pets

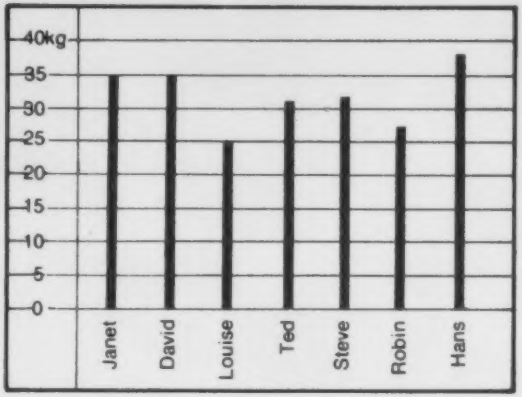


[Pictures drawn or pasted on card.]

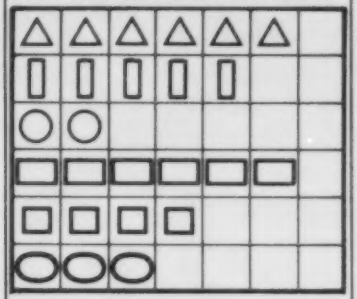
Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)	ii.  [Graph paper on card; objects (counters) placed on grid.]	(b) ii. Place the card before the child. Ask: "How many people had eggs for breakfast?" "What breakfast food did most people eat?" "What breakfast food did fewest people eat?" "Did more people eat sausages then eggs?" "Can you tell me something else you have found out from this graph?"

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)	iii. Our Mass  (Wide strips coloured in, or paper streamers pasted on card)	(b) iii. Place the card before the child. Ask: "Who has the greatest mass?" "Who has the least?" "What is the mass of the lightest child?" "Who has a mass of 32 kg?" "Can you tell me something else that you have found out from this graph?"

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)	iv. Traffic Past Our Window  (Coloured paper shapes pasted on grid)	(b) iv. Place the card before the child. Ask: "How many 'things' (vehicles and pedestrians) went past the window?" "How many kinds of 'things'?" "How many more cars than trucks?" "Were there more buses than bikes?" "Were there more walkers and bikes than cars and taxis?" "Can you tell me something else you have found out from this graph?" "Can you tell me three other things you know from this graph?" (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
40. (continued)	v. Saturday Afternoon	(b) v. Place the card before the child.

Went on a picnic	✓ ✓
Went to a football match	✓ ✓ ✓ ✓ ✓
Went to the Zoo	✓ ✓ ✓
Worked in the garden	✓ ✓ ✓ ✓ ✓
Played in the park	✓ ✓
Watched T.V. at Grandma's	✓
Watched T.V. at home	✓ ✓ ✓ ✓
Each tick ✓ means 10 people	

Ask: "How many people went on a picnic?"
"How many more went to the football than the zoo?"
"How many didn't leave home on Saturday afternoon?"
"How many people watched T.V. at the weekend?"
"Can you tell me something else you have found out about this graph?"

(It is assumed that each person engaged in only one of these activities.)

The above, i-v, constitute five test items at different levels of difficulty. If ten items are required, five further suitable diagrams may be drawn and appropriate questions framed for each. The required number of test items should be presented at a level of difficulty appropriate for the child being tested.

Acceptable Response:

The child gives the correct information orally in response to the questions, and should be able to explain his reasoning when asked "How do you know?" or "Why do you think that?"

If, in v. above, the child answers incorrectly because he has not noted the fact that one tick represents ten people, his attention should be drawn to this statement. If he then answers correctly he is at an intermediate stage. He should be retested at a later date with a *similar* type of test to ascertain if he can then work without prompting.

Note: Answers to the first four questions in v., above, are respectively 20, 20, 90, 50 (people).

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
41. Uses special mathematical vocabulary.		

Procedures for assessing the understanding and use of particular mathematical vocabulary, such as *factor, product, square, prime, composite, sum, difference,* . . . . , have not been included in these test items.

Teachers should be able to discern familiarity with these terms without the use of specific test items.

SHAPE

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **(a) Identifies attributes and (b) uses vocabulary to describe lines and shapes.**	(a) The child's classroom environment, including objects which have attributes appropriate to the child's stage of development. e.g. curved straight round spiral zig-zag plane solid symmetrical (b) Objects in the child's classroom environment, such as: child's table lid of a square box clock face cardboard tube (e.g. from lunch paper roll) window frame spiral cut-out, e.g. snake zig-zag cut-out model of a solid shape, e.g. pyramid chair back knob of T.V. set	(a) **PROCEDURE**: Say: "Show me something round." "Show me something else round." "Show me something straight." "Show me something else straight." "Show me something curved." "Show me something else curved." "Show me something zig-zag." "Show me something else zig-zag." "Show me something spiral." "Show me something else spiral." Make sufficient such requests at the appropriate level, to give the required number of test items. **Acceptable Response**: The child indicates the object with the appropriate attribute. (b) **PROCEDURE**: Point to an object. Say: "Tell me about its shape." Repeat to give the required number of test items, on each occasion selecting an object with a different attribute. **Acceptable Response**: The child describes the object, using vocabulary of shape, e.g. *curved, straight, round, spiral zig-zag, solid, ...* If the child continues to repeat the same attribute for each object (even though this is a correct response, e.g. "solid"), say: "Can you tell me something else about its shape?"

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Classifies shapes; knows and uses correct names for** • square triangle circle oblong • cone sphere pyramid cube cylinder prism **Note:** The relevant tests should be given at the appropriate stage in the learning process.	i. A set of attributes blocks. **Note:** In using attribute blocks for this test the shape of the surface only is being considered. ii. The child's classroom environment.	i. **PROCEDURE:** Place the blocks before the child. Say: "Show me a square." "Show me another square." "Show me a triangle." "Show me another triangle." "Show me a circle." "Show me another circle." "Show me an oblong." "Show me another oblong." "What shape is this block?" "What shape is that block?" The above constitute ten test items. If only five are required, the first item of each each pair may be selected. **Acceptable Response:** The child indicates a block with the correct shape, or gives the correct name for a shape, when asked. ii. **PROCEDURE:** Say: "Show me something in the room which has the shape of a square." "Show me something else which has the shape of a square." "Show me something which has the shape of a circle." "Show me something else which has the shape of a circle", (or "is circular"). "Show me something which has the shape of an oblong." "Show me something else which has the shape of an oblong." "Show me something which has the shape of a triangle." "Show me something else which has the shape of a triangle." "What shape is that window?" "What shape is this plate?" (Continued over)

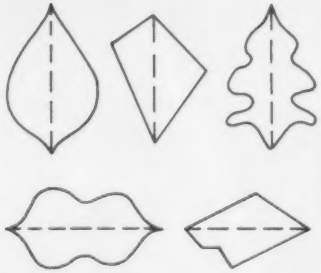
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)		The above constitute ten test items. If only five are required, the first item of each pair may be selected. **Acceptable Response:** The child indicates objects which have the correct shape. He names correctly the shape of the objects nominated.
	iii. A set of models of geometric solids e.g. cones, cubes, cylinders, spheres, pyramids (square and triangular), prisms (rectangular or triangular). (At least two of each.) **Note**: *Models*, not pictures of models. It is not intended that the child use the words in brackets (above).	iii. **PROCEDURE:** Place the models before the child. Say: "Show me a sphere." "Show me another sphere." "Show me a cube." "Show me another cube." "Show me a cone." "Show me another cone." "Show me a pyramid." "Show me a prism." "What shape is this?" (indicating one) "What shape is this?" (indicating another) The above constitute ten test items. If only five are required, the first item of each pair may be selected. **Acceptable Response:** The child indicates objects which have the correct shape. He names correctly the shape of the objects nominated.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)	iv. Environmental objects with the same shapes as the models in ii. above, for example: a cube-shaped box several dice, cereal packets, cigarette packets (rectangular prisms) basket ball, tennis ball (spheres) jam tins, cardboard cylinders (cylinders) witches' hats, ice-cream cones (cones) v. Cards on which is drawn an outline of each of the attribute block shapes, one per card. (large and small circles, squares, triangles, oblongs, . . .) Models of geometric as in iii. above; (spheres, cones, cubes, cylinders, . . .)	iv. **PROCEDURE**: Place the objects before the child. Say: "Show me something with the shape of a sphere." "Show me another." "Show me something with the shape of a cylinder." "Show me another." "Show me something with the shape of a cube." "Show me another one." "Show me something with the shape of a cone." "Show me another one." "What shape has this?" "What shape has this one?" The above constitute ten test items. If only five are required, the first item of each pair may be selected. **Acceptable Response**: The child indicates the object which shows the correct shape or gives the correct name for the shape of the object indicated. v. **PROCEDURE**: Place the cards and models before the child. Say: "Some of these are plane shapes and some of these are solid shapes." ** "Point to four plane shapes." "Point to four solid shapes." "Is this shape plane or solid?" (indicating a plane shape.) "Is this shape plane or solid?" (indicating a different shape.)

** The test proper begins here.

(continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)	Note: *Models*, not pictures of models. vi. Cards on each of which is drawn a symmetrical shape or a non-symmetrical shape. e.g. 	The above constitute ten test items. If only five are required, the first item of each pair may be selected. **Acceptable Response**: The child indicates the plane shapes and solid shapes correctly. He states whether the nominated shapes are plane or solid. vi. **PROCEDURE**: Place the cards before the child. Say: "Some of these shapes are symmetrical and some are not." ** "Show me a symmetrical shape." "Show me another symmetrical shape". "Now another one." "Find a shape which is not symmetrical." "Find another shape which is not symmetrical." "Now another one." "Is *this* one symmetrical or not symmetrical?" "How do you know?" "Is *that* one symmetrical or not symmetrical?" "How do you know?" The above constitute ten test items. If only five are required, a representative selection should be made. **Acceptable Response**: The child responds correctly in each case. In response to the question "How dow you know?" the child should indicate that he understands the nature of symmetry by a response such as "Both sides are the same." "You could fold it in half and the sides would match." "One side looks like the other side." (or similar responses with *are not* or *does not* for non-symmetrical shapes).

** The test proper begins here.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. Sorts shapes.	i. Cards on each of which is drawn one shape, each card being different. Triangles, large, small, right angled, isosceles, equilateral . . . Squares: large, small Oblongs: large, small, and different in proportion Circles: large, small.	i. **PROCEDURE**: Place a large selection of the cards before the child. Say: "Sort these into sets of triangles, circles, squares and oblongs." Ask: "Why did you put these cards in this set?" Repeat to give the required number of test items, on each occasion using a different selection of the cards. **Acceptable Response**: The child sorts the cards correctly, and justifies the basis of his sorting. For example, if questioned about a small equilateral triangle and a large right-angled triangle, the child may say "They've both got three sides."
	ii. A set of models of geometric solids e.g. cones, cubes, cylinders, spheres, pyramids (square and triangular), prisms (rectangular and triangular). (At least two of each.) **Note**: *Models*, not pictures of models. Environmental objects with the same shapes as the models in 3. ii (above)	ii. **PROCEDURE**: Place a large selection of the models and objects before the child. Say: "Sort these into sets according to their shapes." Ask: "Why did you put these things here?" Repeat to give the required number of test items on each occasion using a different selection of the models. **Acceptable Response**: The child sorts the shapes correctly and justifies the basis of his sorting. For example, if questioned about a large cube and a small cube the child may say "They're both cubes."

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)	for example: a cube-shaped box several dice (cubes) cereal packets, cigarette packets (rectangular prisms) basket ball, tennis ball (spheres) jam tins, cardboard cylinders (cylinders) witches' hats, ice-cream cones (cones).	
	iii. The cards used in 3. i above, and the models from 2. iii, of geometric solids, e.g. cones, cubes, cylinders, spheres, pyramids (square and triangular), prisms (rectangular and triangular). (At least two of each.) **Note**: *Models*, not pictures of models.	iii. **PROCEDURE**: Place a large selection of the material before the child. Say: "Sort these into plane shapes and solid shapes." Ask: "Why did you put these things in this set?" Repeat to give the required number of test items, on each occasion using a different selection of the material. **Acceptable Response**: The child sorts the material correctly and justifies the basis of his sorting.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)	iv. Cards on each of which is drawn a symmetrical shape or a non-symmetrical shape. See 2 (vi).	iv. **PROCEDURE:** Place a selection of the cards before the child. Say: "Sort these cards into two sets, one of symmetrical shapes and one of shapes which are not symmetrical." Ask: "Why did you put this shape in that set?" Repeat to give the required number of test items, on each occasion using a different selection of the cards. **Acceptable Response:** The child sorts the cards correctly and justifies the basis of his sorting.

SHAPE

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. Describes the properties of (a) the square, (b) the triangle, (c) the circle, (d) the oblong.		
(a) square	(a) Cards, on each of which is drawn a square. e.g.	(a) **PROCEDURE:** Show the child a card on which a square is drawn. Say: "What is the name of this shape?" Ask: "Why is it a square?" Repeat using other cards, to give the required number of test items. **Acceptable Response:** The child gives the name correctly and describes the properties of a square in a form similar to one of the following: "It has four equal sides and it has four right angles." "All the sides are the same length and the four angles are the same." If the child gives insufficient reasons, for example, "It has four sides." say "Can you tell me anything else?" **Note:** The child may make statements about symmetry in relation to the squares.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. (continued)		
(b) triangle	(b) Cards, on each of which is drawn a triangle. e.g.	(b) **PROCEDURE**: Show the child a card on which a triangle is drawn. Say: "What is the name of this shape?" Ask: "Why is it a triangle?" Repeat using other cards, to give the required number of test items. **Acceptable Response**: The child gives the name correctly and describes the properties of a triangle in a form similar to one of the following: "It has three sides." "It has three angles." "It has three sides and three angles." **Note**: If the triangle is equilateral or isosceles, the child may make statements about its symmetry.
(c) circle	(c) Cards, on each of which a circle is drawn. e.g.	(c) **PROCEDURE**: Show the child a card on which a circle is drawn. Ask: "What is the name of this shape?" "Why is it a circle?"

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. (continued)		Repeat using other cards, to give the required number of test items. **Acceptable Response**: The child gives the name correctly and describes the properties of a circle in a form similar to one of the following: "The outside line (circumference) is the same distance from the centre." "If you fold it anywhere through the centre the two sides match (are symmetrical)." "The boundary is round."
(d) oblong **Note**: Use the word *oblong* instead of *rectangle* here for young children. Definitions given in the N.S.W. Curriculum in Mathematics are – Rectangle: A quadrilateral with four right angles. Oblong: A rectangle whose adjacent sides are unequal.	(d) Cards, on each of which an oblong is drawn. e.g. 	(d) **PROCEDURE**: Show the child a card on which an oblong is drawn. Ask: "What is the name of this shape?" "Why is it an oblong?" Repeat using other cards to give the required number of test items. **Acceptable Response**: The child gives the name correctly, and describes the properties of an oblong in a from similar to one of the following: "It has four sides, the opposite sides are equal, and all the angles are the same." "It has four right-angles and the (two) sides next to each other are not equal." **Note**: The child may make a statement about symmetry in relation to the oblong.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. (continued) (e) All four shapes.	(e) Sets of cards, (a) - (d).	(e) **PROCEDURE**: Select five cards, from the sets (a) - (d), showing a variety of shapes, e.g. square, oblong, circle and two different triangles. For each card say: "What is the name of this shape?" "How do you know it is?" If ten items are required, select ten cards from the sets (a) - (d). using a variety of shapes, and varying the proportions of the sides for the oblongs and triangles. **Acceptable Response**: The child names the shapes and describes the properties correctly.
5. **Applies knowledge of shape in environmental situations.**		The child's understanding of shapes and their properties, and his skill in applying this knowledge, comes about through constant experiments with materials. This can be observed in the class-room through craft activities such as: • paper folding (e.g. origami) • model making (e.g. windmill, witch's hat) (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		• craft tasks (e.g. covering a box with wall paper, making a ship from scrap material) The child's knowledge of the use of shapes in the environment may be assessed from his answers in class discussions to questions such as: "Why are plates round?" "Why are wheels round?" "Why are lids of jars round?" "Why are screws round?" "Why did the Knights sit at a round table?" "Why are most lino tiles square?" "Why do the steel girders in bridges form triangles?" "Why do rectangular wooden gates have a diagonal cross-bar?" "Why is furniture (wardrobes, sideboards) rectangular?" "Why are funnels on ships cylindrical?" . . . . . . **Note**: These questions are not intended as tests of general knowledge but should follow class discussions about the practical use of shapes in the environment.
6. **Uses special vocabulary of shape.**		183

Procedures for assessing the understanding and use of particular geometric vocabulary such as *angle, diagonal, vertical, horizontal,* . . . . , have not been included in these test items. Teachers should be able to discern familiarity with these terms without the use of specific test items.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Compares** **(a) height** **(b) length of two objects.** **Note**: It may be more appropriate with younger children to present tests in the following order: • compares height of two objects which can be moved.(a) i. • compares length of two objects which can be moved.(b) i. • compares height of two objects which cannot be moved. (a) ii. • compares length of two objects which cannot be moved.(b) ii.	(a) i. Suitable moveable objects whose height can be measured. e.g. chairs bottles tall boxes pencil tins (a) ii. Suitable classroom objects whose height can be measured but which cannot be moved. e.g. bookcase bench cupboard teacher's table. (continued over)	(a) i. **PROCEDURE**: Place two objects before the child. Say: "Show me how to find out which one is higher (taller)." Repeat, using other pairs of objects, to give the required number of test items. Ensure that in some of the tests the difference between the objects is small. On some occasions vary the instruction by saying: "Show how to find out which one is lower (shorter)." **Acceptable Response**: The child places the two objects side by side on the same surface to compare their heights, and indicates which one is higher (taller) or lower (shorter). **Note**: Unless the child places the objects upright on the same surface, showing he knows the necessity for a base line, his response is not acceptable. (a) ii. **PROCEDURE**: Nominate two of the objects. Say: "Show me how to find out which of these is taller. You can use anything you like to help you find out." Repeat, nominating other pairs of objects, to give the required number of test items. Vary the instruction on some occasions by substituting "shorter" for "taller". (Continued over)

LENGTH

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. (continued)	Measuring tools such as string tape streamer long stick woollen thread **Note:** The upper part of the object must be within the reach of the child.	**Acceptable Response:** The child compares the heights by using one of the measuring tools to measure *one* of the objects and transfers this measurement to the other object, by means of this "intermediate measure", to enable a comparison to be made. If the child does not *show how to find out* and merely indicates which he thinks is taller or shorter, say: "Tell me how you can prove it."
	(b) i. Suitable moveable objects which can be measured e.g. books pencils sticks flat boxes school cases.	(b) i. **PROCEDURE:** Place two of the objects before the child. Say: "Show me how to find out which one is longer." Repeat, using other pairs of objects, to give the required number of test items. Ensure that in some of the items the difference between the objects is small. Vary the instruction by substituting "shorter" for "longer". **Acceptable Response:** The child places the two objects side by side, ends level, to compare the lengths and indicates which one is longer or shorter. If the child does not *show how to find out* and merely indicates which he thinks is longer or shorter, say: "Tell me how to prove it." **Note:** Unless the child places the ends level, showing the necessity for a base line for comparing length, his response is not acceptable.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. (continued)	(b) ii. Suitable classroom objects whose length can be measured but which cannot be moved. e.g. Chalkboard ledge child's table window sill door opening Measuring tools such as string tape streamer long stick woollen thread	(b) ii. **PROCEDURE**: Nominate two of the objects. Say: "Show me how to find out which of these is longer. You can use anything you like to help you find out." Repeat, nominating other pairs of objects, to give the required number of test items. Vary the instruction on some occasions by saying "shorter", "wider" or "narrower" instead of "longer". **Acceptable Response**: The child compares the lengths by using one of the measuring tools to measure *one* of the objects and transfers this measurement to the other object, by means of the measuring tool, to enable a comparison to be made. If the child does not *show how to find out*, and merely indicates the object he thinks is longer, shorter, wider or narrower, say: "Tell me how you can prove it."
2. **Seriates by comparing three or more objects (a) of different heights and (b) of different lengths.**	(a) Suitable moveable objects whose heights can be compared e.g. bottles vases tins	(a) **PROCEDURE**: Place three or more objects before the child. Say: "Place these in order from the tallest to the shortest." Repeat, using differing numbers of objects, to give the required number of test items. On some occasions vary the instruction by saying "shortest to tallest", "highest to lowest" or "lowest to highest" instead of "tallest to shortest". (Continued over)

LENGTH

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)		**Acceptable Response:** The child places the objects upright on the same surface (base line) and rearranges them into the nominated order by repeatedly comparing heights of adjacent objects.
	(b) Suitable moveable objects whose lengths can be compared e.g. sticks pencils rods knitting needles	(b) **PROCEDURE:** Place three or more objects before the child. Say: "Place these in order from the longest to the shortest." Repeat, using differing numbers of objects, to give the required number of test items. On some occasions vary the instruction by saying "shortest to longest" instead of "longest to shortest". **Acceptable Response:** The child places the objects on the same base line and rearranges them into the nominated order by repeatedly comparing lengths of adjacent objects.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. **Measures with informal units.**	A selection of objects suitable for use as informal units. e.g. pencil, piece of string, short length of dowel stick, a strip of cardboard.	**PROCEDURE:** Show the child the objects with which he can measure. Ask: "How many handspans high is the table?" "How many pencil-lengths across the window sill?" "Measure the chalkboard ledge in cardboard strips." "Measure around the waste paper basket in string-lengths." "How far is it across the hatroom in foot-lengths." Five further test items may be given if desired. **Acceptable Response:** The child carries out the measuring process correctly, ensuring that the successive units are placed so that they neither overlap nor leave spaces. He counts the units correctly and gives his answer orally in a form similar to the following: "Five handspans." "Ten and a half pencil-lengths." "Eight and a bit cardboard strips." "Nearly two string-lengths." "Not quite eleven foot-lengths."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. **Estimates length using informal units, with reasonable accuracy.**	A selection of objects suitable for use as informal units e.g. pencil, piece of string, short length of dowel stick, a strip of cardboard.	**PROCEDURE:** Show the child the objects with which he can check his estimates of length. • Ask: "How far do you think it is across the mat, in foot-lengths?" Say: "See if you are right." • Ask: "How high do you think the cupboard is, measured in pencil-lengths?" Say: "Find out how close you are." • Say: "Estimate how long the table top is in dowel-stick lengths." "Check your estimate." • Ask: "How many string-lengths do you think it is around the lunch basket?" Say: "Measure and see how well you estimated." • Say: "Estimate in cardboard strip lengths the height of the wall between the floor and the chalkboard." "Check by measuring." Five further test items may be given if desired. **Acceptable Response:** The child gives his estimate expressed in the nominated units. As the child checks his estimate, the teacher will be able to judge if this estimate is reasonably accurate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **Measures, choosing the appropriate unit and tool.**	A selection of objects suitable for use as measuring tools: a broom handle a long piece of string a short piece of string several cardboard strips of differing lengths an orange rod a red rod	**PROCEDURE:** Show the child a selection of objects suitable for use as measuring tools. Say: "Choose the best (most suitable, most sensible) of these tools to measure the length of the room." ". . . . . the length of your writing book." ". . . . . how far it is around the waste paper tin." ". . . . . the height of the T.V. set." ". . . . . the length of the light switch plate." Five further test items may be given if desired. **Acceptable Response:** The child makes his measurement correctly, selecting the most appropriate tool. For example, the broomhandle to measure the length of the room, a string to measure around the waste paper tin and the red rod to measure the light switch plate. **Note:** Because the choice of tool is the important aspect of these test items, if the child gives a correct measurement but uses an unsuitable tool (e.g. orange rod to measure the length of the room) his response is *not* acceptable.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. **Realises the need for a standard unit.**		**PROCEDURE:** Tell the child the following story. Ask the question and wait for his response before proceeding to the next part of the test. Say: "Bill says the room is ten broomsticks long, Tom says it measures nine pieces of string and Mary says it is forty-five pencils long. They all used their tools correctly, and yet their measurements are all different. Why is this?" Say: "Bill says the room is 15 footsteps long, Tom says it is 16 footsteps long and Mary says it is 17 footsteps long. They all measured the room correctly with their footsteps and yet their measurements are still different. Why is this?" Ask: "How could they measure correctly and get the same answer?" Ask: "Why would it be better to measure with a metre stick?" *All* the above constitute the one test item, each part of which must be answered correctly for success in this objective. **Acceptable Response:** The child gives answers which show that he realises that in the first instance the measures were made with different tools as units, and in the second instance that not all footsteps are the same length. He states in his own words that a uniform measure would give a uniform answer, and that the metre is a standard measure in widespread use.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. **Measures with a standard unit.** **Note:** The word "rule" is used to refer to a measuring instrument. (A "ruler" is an instrument for drawing straight lines.)	i. 20 cm rule 30 cm rule 50 cm rule metre stick tape measure	i. Using the rule as a measuring unit, counting the number of consecutive placements to describe the length of the object measured. **PROCEDURE:** Give the child an appropriate rule. Select for measurement an object longer than the rule, e.g. a mat. Say: "Measure the length of the mat." Repeat, nominating other objects, to give the required number of test items. **Acceptable Response:** The child carries out the activity and gives his answer in a form similar to the following: "This table is nearly three 20 cm rules wide." "This cupboard is a bit more than two 50 cm rules high." "Our room is seven metre-sticks long." **Note:** It is not required that the child gives his answer in centimetres, for example, "This table is nearly 60 centimetres wide." Such an answer is, however, acceptable.
	ii. A 20 cm, 30 cm, or 50 cm rule without numerals, marked in centimetre units. (continued over)	ii. Using a rule to measure an object shorter than the rule. **PROCEDURE:** Give the child one of the rules. Nominate an object shorter than the rule. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. (continued)	A 20 cm, 30 cm or 50 cm rule with numerals, marked in centimetre units.	Say: "Measure this . . . . . How many centimetres long is it?" Repeat, nominating other suitable objects and varying the rule used, to give the required number of test items. **Acceptable Response:** The child measures the object, first placing the zero mark of the rule to coincide with the "beginning" of the object, and noting where the object "ends". If using the unnumbered rule the child counts the centimetre intervals. If using the numbered rule he reads the scale. He states his answer in a form similar to the following: "The book is almost ten centimetres long." **Note:** The child must correctly align the zero mark on the rule with the object before measuring. If he fails to do so his response is not acceptable.
	iii. A trundle wheel.	iii. Using a trundle wheel to measure in metres. **PROCEDURE:** Give the child a trundle wheel. Say: "Use this to find out how long the path is." Repeat, to give the required number of test items, nominating other tasks, with distances no longer than 30 metres.

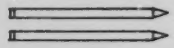
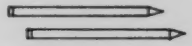
Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. (continued)		**Acceptable Response:** The child uses the trundle wheel correctly, counts the clicks accurately and states his answer in a form similar to the following: "The path is a bit more than ten metres long." **Note:** The teacher must observe the child as he carries out the action.
8. **Estimates length using standard units.**	20 cm rule 30 cm rule 50 cm rule metre stick tape measure A 20 cm, 30 cm, or 50 cm rule without numerals, marked in centimetre units. A 20 cm, 30 cm or 50 cm rule with numerals, marked in centimetre units.	**PROCEDURE:** Show the child the measuring tools he can use to check his estimates. Say: "How many metres long do you think the room is?" Say: "See if you are right." Ask: "How many centimetres wide do you think this book is?" Say: "See if you are right." Repeat, to give the required number of test items, selecting other objects, sometimes asking for metre estimates, sometimes for centimetre estimates; include length, width and height. **Acceptable Response:** The child gives his estimate expressed in the nominated units. As the child checks his estimate, the teacher will be able to judge if this estimate is reasonably accurate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
9. **Knows relationship between centimetre and metre.**	i. A metre stick without numerals, marked in centimetre intervals.	i. **PROCEDURE:** Show the child a centimetre interval on the metre stick. Say: "How many of these on the metre stick?" The above is the only test item to be given for this procedure. **Acceptable Response:** The child answers "one hundred".
	ii. No material is required.	ii. **PROCEDURE:** Ask: "How many centimetres in a metre?" The above is the only test item to be given for this procedure. **Acceptable Response:** The child answers "One hundred centimetres". **Note:** If desired, knowledge of the fractional relationship may be tested by asking: "What part of the metre stick is this interval?" (indicating a centimetre space) "What part of a metre is a centimetre?"

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. **Conserves length.**	i. Lengths of flexible material string ribbon cord woollen thread rope.	i. **PROCEDURE:** Show the child the length of ribbon fully extended. Place the ribbon on the table so that it assumes a curved position, for example: Ask: "Is the ribbon still as long?" or "Is there still the same length of ribbon?" "Why do you think that?" Show the child the length of cord fully extended. Form it into a close zig-zag on the table. Ask: "Is the cord still as long?" or "Is there still the same length of cord?" "Why do you think that?" Show the child the length of string fully extended. Wind it around your fingers. Ask: "Is the string still as long?" or "Is there still the same length of string?" "Why do you think that?" (Continued over)

LENGTH

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)		Show the child the length of wool, fully extended. Measure it on the metre rule, and tell the child the measurement, for example, "fifty centimetres." Cut the wool into two segments. Ask: "Is there still fifty centimetres of wool?" "Why do you think that?" Repeat any of the items, varying the material, to give the required number of test items. **Acceptable Response:** The child responds "yes" to the first question. In reply to the question "Why do you think that?" his answer must indicate that he knows nothing has been added or removed and only the position of the parts has been changed.
	ii. Pairs of objects the same in length two pencils two sticks two straws two knitting needles two strips of cardboard	ii. **PROCEDURE:** Place the two pencils before the child, parallel to each other, ends level and a space between.  Ask: "Are the pencils the same length?" Move one of the pencils so that the ends are not level. 

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)		Ask: "Are the pencils still the same length?" "Why do you think that?" Repeat, using other pairs of objects, and adapting the wording, to give the required number of test items, on different occasions varying the amount of movement from the original position. e.g. **Acceptable Response:** The child responds "yes" to the first question on each occasion. If he answers "no", it is pointless to continue with the second question.

LENGTH

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
11. **Applies knowledge of length in environmental situations.**		The child's skill in applying knowledge of length in the environment can be observed in the classroom as the child finds answers to questions such as: "What things are sold by length?" "What is there in the room that might be one metre wide?" "How far is it around your waist?" "How high can you jump?" Further observations can be made as the child engages in craft activities involving measurement, and in his work with length graphs while collecting, recording and interpreting information.
12. **Uses special vocabulary of length.**		

Procedures for assessing the understanding and use of special vocabulary of length such as *wide, width, high, height, long, length, narrow, narrowest, rule, ruler,* . . . . . , have not been included in these test items. Teachers should be able to discern familiarity with these terms without the use of specific test items.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Compares the mass of objects through lifting ("hefting"), pushing and pulling.**	Objects of differing mass suitable for lifting, pushing or pulling by a child. e.g. rod boxes, empty and full attribute block boxes empty and full shoe-box full of pebbles shoe-box full of sand empty shoe-box carton of shredded paper carton of books empty carton waste paper basket **Note:** Boxes and cartons should have lids on and be tied up with string or cord to provide a "handle" for pulling or lifting.	**PROCEDURE:** Place two suitable objects before the child. Say: "Lift these to find out which one is heavier." Place two suitable bulky objects on a smooth floor. Say: "Push or pull these to find out which one is heavier," Repeat with other suitable pairs of objects to give the required number of test items. On some occasions vary the instructions by saying ". . . . . to find out which one is lighter." ". . . . . to find out which one has the greater mass." ". . . . . to find out which one has the smaller mass." On some occasions ask the child to lift, on others to push or pull. The child, when lifting, may hold an object in each hand simultaneously, or may "feel" the objects one after the other. **Acceptable Response:** The child selects the correct object. **Note:** The pairs of objects used in each test should be approximately the same size, so that the child must make his judgement based on "pull" or resistance, rather than on bulk.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Understands that size or shape does not determine mass.**	Pairs of objects with the same mass, but differing greatly in size or shape. Pairs of objects the same in size or shape but differing greatly in mass.	**PROCEDURE:** Place one of the pairs of objects before the child. Say: "Lift (hold), or push or pull these to find out which one is heavier." Repeat with other pairs of objects, to give the required number of test items. If desired the substitutions of wording suggested for 1 above may be used. **Acceptable Response:** The child states correctly that the objects are the same in mass, or selects the correct object if they are different in mass.
3. **Understands the use of the beam balance.**	i. A beam balance Objects for placing on the pans of the beam balance e.g. plasticine ball nails marbles sinkers rice centicubes beads.	i. **PROCEDURE:** Put the beam balance in front of the child. Put the plasticine ball on one of the pans. Indicate the nails. Say: "Put the nails on the other pan to obtain the same mass as the plasticine ball." Repeat, using other materials, to give the required number of test items, sometimes starting with the left-hand pan and sometimes with the right-hand pan.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)		**Acceptable Response**: The child performs the action to obtain as nearly as possible a level beam on the balance.
	ii. a beam balance Objects for placing on the pans of the beam balance e.g. plasticine nails marbles sinkers rice centicubes beads.	ii. **PROCEDURE**: Put the beam balance in front of the child. Place objects on the pans so that: • The right-hand pan is lower than the left, or • The left-hand pan is lower than the right, or • The pans give a level beam on the balance. After each placement on the pans ask: "What can you tell me about the mass of these things?" Repeat, using various materials in the pans, to give the required number of test items. **Acceptable Response**: The child observes the beam of the balance and responds in a form similar to the following (using the vocabulary of mass): "The marbles are heavier than the sinkers." "The rice has less mass than the nails." "The counters and the centicubes have the same mass." (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)		**Note:** If the child uses size, quantity or number vocabulary (e.g. smaller than, less than . . . . .) his answer is not acceptable. For example, the following are *not* satisfactory. The rice is less than the sand. The marbles are smaller than the nails.
4. **Measures mass using informal units.**	A beam balance Objects whose mass is to be found Objects to be used as informal units e.g. plasticine nails marbles sinkers rice centicubes beads	**PROCEDURE:** Put the beam balance before the child. Show him one of the objects whose mass is to be found. Ask: "What is the mass of this object in marbles?" or "How many marbles have the same mass as this object?" Repeat, asking for the mass of other objects using different informal units, to give the required number of test items. **Acceptable Response:** The child carries out the measuring process correctly, obtaining as nearly as possible a level balance, and states the mass of the object in the nominated units. For example, "The block has the same mass as ten marbles."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **Seriates by comparing the mass of two, three, or four objects by means of the beam balance.**	A beam balance Objects of varying mass.	i. **PROCEDURE:** Place the beam balance before the child. Give him two of the objects. Say: "Use the beam balance, and place these in order of mass from the heavier to the lighter." Repeat with other pairs of objects to give the required number of test items, sometimes varying the instruction by saying "lighter to heavier." **Acceptable Response:** The child places the objects on the beam balance and then arranges them in the nominated order. ii. **PROCEDURE:** Place the beam balance before the child. Give him three or four of the objects. Say: "Use the beam balance to help you, and then place these in order of mass from the heaviest to the lightest." Make a mark in a suitable place on the child's table. Say: "Start here." Repeat, to give the required number of test items, using other objects, sometimes varying the instruction by saying "lightest to heaviest." **Acceptable Response:** The child places the objects on the beam balance comparing two at a time, and then arranges all the objects in the nominated order.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. **Estimates mass using informal units, with reasonable accuracy.**	A beam balance. A selection of objects whose mass in to be estimated, e.g. a lump of plasticine a large potato a box of sand each in a small plastic bag. A selection of materials to be used as informal units e.g. nails beads rice marbles. A number of empty plastic bags identical with those holding the plasticine, potato etc.	**PROCEDURE**: Place before the child the beam balance and the materials. Say: "Take this lump of plasticine in your hands." Give the child an empty plastic bag. Ask: "How much rice do you think you will have to put in this bag to give the same mass as the plasticine?" Say: "Use the beam balance to find out if you are right." Repeat, using other objects and other informal units, to give the required number of test items. **Acceptable Response**: After handling the object and the units, the child gives his estimate. He uses the form "this much rice." "this amount of nails," "this many counters." He is not required to give a numerical answer, for example, "twelve nails." As the child checks his estimate, the teacher will be able to judge if it is reasonably accurate.

OBJECTIVES. The Child . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. **Realises the need for standard units.**	No materials needed.	**PROCEDURE:** Say: "Tom says this box has the same mass as 20 pebbles, Dick says it has the same mass as 25 pebbles and Harry says 15 pebbles. They all used the beam balance correctly, and yet their measurements are different. Why is this?" Ask: "How could they measure correctly, and get the same answer?" Ask: "Why would it be better to measure in grams or kilograms?" All the above constitute one test item, each part of which must be answered correctly for success in this Objective. This test item is the only one required. **Acceptable Response:** The child gives answers which show that he realises that pebbles vary in mass. He states, in his own words, that a uniform unit of measure would give a uniform answer, and that grams and kilograms are standard measures in widespread use.
8. **Measures with standard units.**	A beam balance Centicubes (each centicube has a mass of 1 gram) Mass-pieces e.g. 5g, 10g, 50g, 100g, 200g, 500g, 1 kg. (continued over)	**PROCEDURE:** Place the beam balance, the centicubes, and the mass-pieces before the child. Show him one of the objects. Say: "Find the mass of this object." Repeat, using other objects, to give the required number of test items. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
8. (continued)	Objects whose mass is to be measured. These objects should previously be prepared so that they can be measured with an exact number of the available mass-pieces.	**Acceptable Response:** The child balances the object correctly and states his answer in standard units. As the child carries out the balancing the teacher should observe if he chooses appropriate mass-pieces.
9. Estimates mass using standard units, with reasonable accuracy.	A beam balance Centicubes (each centicube is 1 gram in mass) Mass-pieces e.g. 5g, 10g, 50g, 100g, 200g, 500g, 1 kg. Objects whose mass is to be measured. These objects should previously be prepared so that they can be measured with an exact number of the available mass-pieces.	**PROCEDURE:** Place the beam balance and materials before the child. Show him one of the objects. Ask: "What do you think is the mass of this object?" Say: "Use the beam balance to find out if you are right." Repeat, selecting other objects, to give the required number of test items. **Acceptable Response:** The child gives his estimate in grams or kilograms. As the child checks his estimate the teacher will be able to observe if he chooses appropriate mass-pieces, and to judge if his estimate is reasonably accurate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. **Conserves mass.**	i. Two identical balls of playdough.	i. **PROCEDURE:** Show the child the two balls of playdough. Let him hold them, one on the palm of each hand. Ask him to tell you about the balls. Establish with him that they are as heavy as each other, i.e. that they have the same mass. Give the child one of the balls. Leave the other ball untouched throughout, as a reference. Say: "Roll your ball into a 'snake'." Ask: "Has the 'snake' the same mass as the ball? Why do you think that?" Say: "Change the 'snake' into a 'pancake'." Ask: "Has the 'pancake' the same mass as the ball? Why do you think that?" Repeat, asking the child to re-form his playdough into other shapes, to give the required number of test items, on each occasion asking if the new "shape" has the same mass as the reference ball. **Acceptable Response:** The child responds to show that he understands that his piece of playdough has the same mass as the reference ball, through all the transformations of shape.
	ii. Clay Plasticine Playdough	ii. **PROCEDURE:** Show the child a lump of playdough rolled into a ball. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)		Roll the ball into a 'snake'. Ask: "Has the playdough the same mass as before?" Flatten the ball into a 'pancake'. Ask: "Has the playdough the same mass as before? Why do you think that?" Repeat, re-forming the playdough into other shapes, to give the required number of test items. **Acceptable Response:** The child responds to show that he knows the mass remains constant through all the transformations of shape; nothing has been added or removed.
	iii. Clay plasticine playdough	iii. **PROCEDURE:** Show the child a lump of plasticine rolled into a ball. Break or cut the ball into two pieces. Ask: "Is the mass of these two pieces the same as before?" "Why do you think that?" Repeat, breaking the ball into three or more pieces, to give the required number of test items. **Acceptable Response:** The child responds to show that he knows that the mass remains constant irrespective of the number of pieces into which the ball is broken.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)	iv. Split peas rice beads Containers saucers	iv. **PROCEDURE:** Place before the child a plastic bag containing some rice. Transfer the rice on to two saucers. Ask: "Has the rice the same mass as before?" "Why do you think that?" Return the rice to the plastic bag. Repeat, transferring the rice on each occasion to three or more saucers, or using other materials, to give the required number of test items. **Acceptable Response:** The child responds to show that he knows that the mass remains constant irrespective of change of position.
	v. Two balls of clay with the same mass Beam balance	v. **PROCEDURE:** Place the balls one on each pan of the balance to show the child the mass is the same. Remove the balls. Break one ball into two pieces. Ask: "Have these two pieces of clay still the same mass as the ball?" "Why do you think that?" (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)		Re-from the clay into a ball and place beside the first ball. Repeat, to give the required number of test items, on some occasions breaking the second ball into three or more pieces, on other occasions transforming it into shapes such as snake, sausage, pancake, spiral. **Acceptable Response:** The child responds to show that he knows that the equality of mass of the two balls has been preserved through all the physical changes of the second ball.
11. **Applies knowledge of mass in environmental situations.**		The child's skill in applying knowledge of mass in the environment can be observed in the classroom as he finds answers to questions such as: • What things are sold by mass? • What is there in the room that might be a kilogram in mass? • Who has the greatest mass, Tom, Dick or Harry? Further observations can be made as the child engages in activities such as shopping play, and in collecting, recording and interpreting information when making graphs with mass measurements.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
12. Uses the special vocabulary of mass.		

Procedures for assessing the understanding and use of special vocabulary of mass such as: *heavy, light, balance, the same mass, greater mass, smaller mass, heaviest, lightest, greatest, least, ...*, have not been included in these test items. Teachers should be able to discern familiarity with these terms without the use of specific test items.

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Understands the terms full and empty.** **Note:** A container is "full" only if it will not hold any more.	i. Jugs, bottles, jars, ... , containing varying amounts of coloured liquid, ranging from empty to full.	i. **PROCEDURE:** Show a selection of the prepared containers to the child. Say: "Show me the empty ones." "Show me the full ones." Repeat to give the required number of test items, on each occasion varying the selection of containers. **Acceptable Response:** The child selects the appropriate containers, indicating all the empty ones, and then all the full ones. Alternatively, he may consider each container in turn and state whether it is full or empty, nearly empty, half full, ...
	ii. Ten jugs, bottles, jars, ... , containing varying amounts of coloured liquid, ranging from nearly empty to nearly full. A bucket of water a dipper and a funnel.	ii. **PROCEDURE:** Show one of the containers to the child. Say: "Make this container full." Repeat, using other containers to give the required number of test items, on some occasions saying "empty" instead of "full". **Acceptable Response:** The child adds sufficient water to make the container full, or pours out all the water to make the container empty, whichever is appropriate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Measures capacity using informal units.**	Coloured water Jugs, buckets, jars, . . . Tea cups, spoons, egg cups, . . . A dipper and a funnel. **Note**: Sand or other suitable fluid substances may be used instead of water.	**PROCEDURE**: Place the coloured water, dipper and funnel before the child. Ask: "How many tea-cupfuls of water will fill this jug?" Repeat, to give the required number of test items, varying the nominated containers and the informal units chosen. **Note**: If the child has difficulty in carrying out the activity with water due to spillage problems, the same activities may be performed using fine sand. **Acceptable Response**: The child carries out the measuring process correctly, filling the container so that it will not hold any more, and states the capacity of the object in the nominated units. For example: "This jugful is equal to five cupfuls." or "The capacity of this jug is five cupfuls." or "This jug will hold five cupfuls." When the measure cannot be stated in terms of whole units the child may state, for example: "This jar holds a bit more than fourteen spoonfuls." "This buckets holds nearly five jugfuls."

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. **Compares the capacity of containers.** **Note**: This includes: i. Direct comparison of two containers of different capacity. ii. Direct comparison of two containers of the same capacity but different shape. iii. Comparison of two containers using intermediate measure (informal unit). iv. Comparison of three containers.	i. Containers such as cups, jugs, bottles, jars, whose capacity can be compared. A bucket of coloured water Dipper Funnel **Note**: The capacity of each container should be different from all the others.	i. **PROCEDURE:** Show the child the coloured water. Give him two of the containers, for example, a cup and a bottle. Ask: "Which of these holds more? Which holds less? You can use the coloured water to help you find out." Repeat, to give the required number of test items, on each occasion choosing two different containers. The containers selected should be such that the child cannot give a correct response based on visual judgement alone; for example, a very large bottle and a very small cup would not be a suitable pair for comparison. On some occasions ask only "Which holds more?" and on others only "Which holds less?" On others ask "Which holds more and which holds less?" Each question provides one test item. **Acceptable Response:** The child fills one container with water and pours the water into the other container. The water will either fill the second container and leave some over, or will all go into the second container, leaving some space. After observing this result, the child should be able to reach a conclusion about the relative capacity of the containers, and should be able to state, for example: "The bottle holds more. The cup holds less." In response to the question "How do you know?" the child may give reasons such as "The water would overflow if I poured it all in the cup, so the bottle holds more." "There is still a space left in the bottle after I pour in a cupful."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)		**Note:** If the child is uncertain how to proceed say, "Fill one of them with water and pour it into the other. What does that tell you?" If the child then makes the correct deduction he has reached an intermediate stage.
	ii. Pairs of containers different in shape but the same in capacity. A bucket of coloured water Dipper Funnel.	ii. **PROCEDURE:** Show the child the coloured water. Give him two containers, different in shape, but alike in capacity. Ask: "Which holds more? You can use the coloured water to help you find out." Repeat, using other pairs of containers, to give the required number of test items. **Acceptable Response:** The child fills one container with water and pours it into the other, noting that the second container is now full, and that there is no water left in the first. He then states that both containers have the same capacity, in a form such as: "The cup and the tin hold the same amount." "They're both the same." "They hold as much as each other." **Note:** If the child is uncertain how to proceed, say "Fill one of them with water and pour it into the other. What does that tell you?" If the child then makes the correct deduction he has reached an intermediate stage.
	iii. Containers such as jugs, bottles, jars, whose capacity can be compared. (continued over)	iii. **PROCEDURE:** Show the child the coloured water, dipper and funnel, also the vessels to be used as informal measuring tools. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)	A bucket of coloured water, with which to fill the containers. dipper funnel Small vessels, e.g. baby food tin tablespoon teacup to be used as informal measuring tools.	Give the child two of the containers. Ask: "Which holds more? Which holds less?" Indicate the small vessels. Say: "Use one of these to measure." Repeat, to give the required number of test items, on each occasion giving the child two different containers. **Acceptable Response:** The child selects a suitable measuring tool and fills each container, counting the number of units poured into each. He then states which container holds more and which holds less in a form similar to one of the following: "The jug holds more than the milk bottle." "The milk bottle holds less than the jug." "The jar holds more, the bottle holds less." "The jar holds five teacupfuls and the bottle holds four teacupfuls, so the jar holds more than the bottle."
	iv. Containers such as jugs, bottles, jars, whose capacity can be compared. A bucket of coloured water with which to fill the containers. (continued over)	iv. **PROCEDURE:** Show the child the coloured water and the measuring tools as before. Give the child three of the containers. Ask: "Which holds most and which holds least?"

Continued

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)	dipper funnel Small vessels, e.g. baby food tin tablespoon teacup to be used as informal measuring tools.	Repeat, to give the required number of test items, on each occasion giving the child three different containers. **Acceptable Response**: The child selects a suitable measuring tool and fills each container, counting the number of units poured into each. He then states which container holds most and which contains least in a form similar to one of the following: "The jug holds the most and the vase holds the least." "The bottle holds nine tinfuls, the jug holds ten tinfuls and the vase holds nearly six tinfuls, so the jug holds the most and the vase holds the least."
4. **Seriates three or more containers according to capacity.**	Containers such as jugs, bottles, jars, whose capacity can be compared A bucket of coloured water with which to fill the containers. dipper funnel Small vessels, e.g. baby food tin, tablespoon, teacup, to be used as informal measuring tools.	**PROCEDURE**: Show the child the coloured water, dipper and funnel. Give the child three or more containers. Say: "Arrange these in order, starting from the one that holds the most, and ending with the one that holds the least." Repeat, to give the required number of test items, varying the numbers of containers given to the child, and sometimes nominating the order from least to most. **Acceptable Response**: The child selects an informal measuring tool, and measures the capacity of each container in terms of the chosen unit. He then arranges the containers in the nominated order, basing his judgment on the numbers of units for each.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **Estimates capacity using informal units, with reasonable accuracy.**	Containers such as jugs, bottles, jars, whose capacity can be estimated A bucket of coloured water with which to fill the containers. dipper funnel Small vessels, e.g. baby-food tin, tablespoon, teacup, to be used as informal measuring tools.	**PROCEDURE:** Show the child the coloured water, dipper and funnel, also the vessels to be used as informal measuring tools. • Ask: "How many cupfuls do you think this bottle will hold?" Say: "Find out if you are right." • Say: "Estimate how many jugfuls this bucket will hold." "Measure and see how close you are." • Ask: "How many spoonfuls do you think this cup holds?" Say: "Check your estimate." • Say: "Estimate how many bottlefuls this jar will hold." "Measure and see if you estimated correctly." • Say: "Estimate the capacity of the milk bottle in cupfuls." Ask: "How close was your estimate?" The above constitute five test items. If ten are required, five further items may be presented, using a variety of containers and informal units. **Acceptable Response:** The child gives his estimate expressed in the nominated units. As the child checks his estimate, the teacher will be able to judge if this estimate is reasonably accurate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. **Understands conservation in relation to capacity.** (The volume of a fluid is not changed when the fluid is poured into different vessels.)	Pairs of similar containers with the same capacity. Other vessels, of markedly different shapes and sizes, some with the same capacity as those above. Coloured water. **Note**: Fluid substances such as sand may be used if liquids present a difficulty because of a child's lack of manipulative skill.	i. **PROCEDURE**: Fill two identical bottles with coloured water. Ensure that the child knows that they both hold the same amount. Leave the first bottle untouched throughout. Pour all the water from the second bottle into a tall "thin" container. Ask: "Does *this* (indicating the 'new' container) have as much water in it as the first bottle?" "Why do you think that?" Return the water to its original bottle. Pour all the water from this bottle into a shallow "flat" container. Ask the same questions as before. Return the water to its original bottle. Pour all the water from this bottle into a number of cups. Ask: "Do these cups have the same amount of water as the first bottle?" "Why do you think that?" Return the water to its original bottle. Pour all the water from this bottle into a variety of differently shaped small vessels. Ask: "Do these containers have the same amount of water as the first bottle?" "Why do you think that?" Repeat these activities to give the required number of test items, beginning with other pairs of identical containers and pouring from the second into variously shaped containers, or into various numbers of smaller containers. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. (continued)		**Acceptable Response:** The child maintains that there is the same amount of water in spite of change in the shape or the number of the containers. He indicates his understanding of conservation by stating in his own words that he knows nothing has been added or removed, and, where applicable, that the height of a container compensates for the width. ii. **PROCEDURE:** The procedures are as for i., but without a "reference" container. Fill one of the containers with coloured water. Pour the water into a differently shaped container. Ask: "Is there still as much water as before?" "Why do you think that?" Return the water to the original container. Repeat to give the required number of test items, on each occasion pouring the liquid into a differently shaped container, or into various numbers of smaller vessels. **Acceptable Response:** The child maintains that there is the same amount of water in spite of change in the shape or the number of the containers. He indicates his understanding of conservation by stating in his own words that he knows nothing has been added or removed, and, where applicable, that the height of a container compensates for the width.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. Realises the need for a standard unit.		**PROCEDURE:** Tell the child the following story. Ask the question and wait for the response before proceeding to the next part of the test. Say: "Ann says the bucket holds ten bottlefuls, Betty says it holds six jugfuls and Carol says it holds twenty tinfuls. They all measured correctly and yet the numbers are different. Why is this?" Say: "Dot says the jug holds fifteen spoonfuls, Emma says it holds twenty-one spoonfuls and Fred says it holds sixty spoonfuls. They each brought their own spoon from home and they all measured correctly and yet the numbers are all different. Why is this?" Ask: "How could they measure correctly and get the same answer?" Ask: "Why would it be better to use a litre measure?" All the above constitute one test item, each part of which must be answered correctly for success in this Objective. This test item is the only one required. **Acceptable Response:** The child gives answers which show that he realises that in the first instance the measures were made with different measuring units, and in the second instance that not all spoons hold the same amount. He states in his own words that a uniform measure would give a uniform answer, and that the litre is a standard measure in widespread use.

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
8. **Measures with a standard unit (litre).**	A litre jug. A number of containers with capacity of a litre or more. A bucket of coloured water, funnel, dipper.	**PROCEDURE:** Show the child the coloured water, funnel, dipper and litre jug. Nominate one of the containers. Say: "How many litres does this jar hold?" Repeat, to give the required number of test items, nominating other large containers whose capacity is to be measured in litres. **Acceptable Response:** The child finds the capacity of the container, by correctly filling and re-filling the litre measure, and counting the number of litres poured into the container. He states the capacity to the nearest litre, in a form similar to one of the following: "The jar holds nearly two litres." "The bucket will hold a little over four litres." "The vase holds about one and a half litres." "The capacity of the bottle is one litre."

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
9. **Estimates capacity using a standard unit (litre), with reasonable accuracy.**	A litre jug A bucket of coloured water, dipper, funnel. Containers whose capacity is to be estimated.	**PROCEDURE:** Show the child the coloured water, dipper, funnel, and litre jug. Ask: "How many litres do you think this holds?" ("will hold?") Say: "Measure and find out if you are right." Repeat, nominating other containers, to give the required number of test items. **Acceptable Response:** The child gives his estimate expressed in litres. As the child checks his estimate, the teacher will be able to judge if this estimate is reasonably accurate.

10. **Applies knowledge of capacity in environmental situations.**		The child's skill in applying knowledge of capacity in the environment can be observed as the child:
		
		• carries out classroom tasks, e.g. fills flower vases, fills painting jars
		
		• engages in activities which involve using or measuring fluid and liquid substances, such as
		
		  • afternoon-tea party dramatisation
		  • playing shops
		  • using recipes for cooking simple foods.
		
		• discusses articles sold by capacity (Continued over)

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
10. (continued)		• discusses commodities sold by fluid measures • makes or interprets graphs based on capacity • finds out how much liquid (or fluid) is in a partly filled container (by measuring with an informal unit such as a cup, or by measuring with a formal unit such as a litre jug, or by pouring into a calibrated vessel and reading the scale). Answers may be given in the from: "about three and a half cupfuls" "nearly a litre" "a little over half a litre" "the scale says '600 ml' ".
11. **Uses special vocabulary of capacity.**		

Procedures for assessing the understanding and use of special vocabulary of capacity, such as *holds more, holds less, holds least, capacity, fluid, liquid,* . . . . . , have not been included in these test items. Teachers should be able to discern familiarity with these terms without the use of specific tests.

The word *volume* is not used at this stage. The concept of *capacity only* is dealt with. (Hence tests to find the volume of liquids in partly filled vessels are not included. In class activities children are asked "How much water is in the bucket?" but not "What is the volume of water in the bucket?")

VOLUME (CAPACITY)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.

Note: *Capacity* refers to the amount of substance a vessel holds when full (or will hold, when full).

Volume refers to the amount of substance of the container itself *plus* the amount of substance it holds (or will hold) when full.

Thus the capacity of a bottle is the amount of substance (air, fluid, etc.) it is capable of holding; the volume of the bottle is the amount of glass of which it is made *plus* the amount of substance it is capable of holding.

(Briefly: capacity is contained volume.)

Capacity is usually expressed in liquid measures, e.g. litre, millilitre.

Volume is usually expressed in cubic measures, e.g. cubic metre, cubic centimetre.

AREA

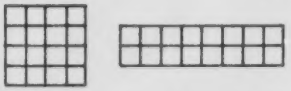
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Understands the term "covering a surface".** **Note:** "Covering" in this mathematical sense means having no overlap of units and leaving no space between units.	Classroom objects with flat surfaces: e.g. Table Bookshelf Mat Picture-book (a) A classroom mat Sheets of art paper (a few more than are necessary to cover the mat) (b) A picture book of quarto size or larger Playing cards (a few more than necessary to cover the book) continued	i. **PROCEDURE**: Have the table top clear of any objects. Say: "Show me the surface of this table." Repeat for the shelf, mat, picture book, ... , to give the required number of test items. **Acceptable Response**: The child must run his hand over the entire top surface of the object. If he merely points, or places a finger on the surface in one place, his response is not acceptable. Probe further by asking "Is that *all* of the surface?" If the child then indicates the surface correctly, his response may be accepted. ii. **PROCEDURE**: (a) Use the classroom mat and the sheets of art paper. Place the mat on the floor. Give the child the sheets of paper. Say: "Cover the surface of the mat with this paper." Repeat the procedure, adapting the words of the instruction, using in turn (b) the picture book and playing cards (c) book shelf and exercise books (d) table top and square lino tiles (e) table top and round ice-cream container lids. Continued

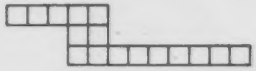
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. (continued)	(c) A book shelf (clear of objects) Uniform exercise books (a few more than necessary to cover the shelf) (d) A table (top clear of objects) Square lino tiles (a few more than are necessary to cover the tabletop) (e) A table (top clear of objects) Lids of round ice-cream containers (sufficient in number to carry out the test)	If ten test items are required, five further similar items may be presented. **Acceptable Response:** (a) The child places the sheets of paper on the surface of the mat (with reasonable accuracy) so that the sheets do not overlap each other and no spaces are left between sheets. It may be necessary, for complete coverage of the surface, for parts of sheets to extend beyond the boundary. (b), (c), (d) Similar responses are required, using the different materials. (e) The child places the lids as closely as possible on the table top, finds that he can make the lids touch without overlapping, but that always spaces are left. He then must state that the surface is not covered. He may indicate a further level of understanding by a response such as "You can't cover it with that shape." If he places the lids over the table top but makes no statement, prompt him by asking: "Have you covered the surface?" **Note:** A child's response is not acceptable if there is overlapping of units (see definition of *covering*, page 212). If the tester is uncertain whether the overlapping of units takes place because • the child feels it is wrong to place parts of units outside the boundary, or • the units on the boundary "fall off" unless the child overlaps them (in b, c, d or e) then these test items should be repeated, using the same units to cover a surface of similar dimensions at floor level.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Covers a surface using informal units, and discovers the number of units required (i.e. finds the area).**	Surfaces to be covered with informal units Objects to serve as informal units. **Note:** These materials must be prepared in advance, so that an exact number of units cover the surfaces to be measured. Several extra units of each type are to be included in the set given to the child. Examples of suitable surfaces and units are: • A sheet of art paper cut to an appropriate size Matchboxes as units (see note above) • A sheet of cardboard cut to an appropriate size Uniform exercise books as units (see note above) • A piece of felt cut to an appropriate size Playing cards as units (see note above).	**PROCEDURE:** Place the prepared art paper before the child. Give him the matchboxes. Say: "Cover the surface of the paper with matchboxes and find out how many are needed to do this." Repeat, using other prepared materials, to give the required number of test items. **Acceptable Response:** The child covers the surface correctly with the nominated units, and counts the number used. (He may also, if asked, make a statement about the area of the surface being measured. For example: "The area of the paper equals fifteen matchboxes.") **Note:** Estimation activities may be given, based on these tests, if desired. The same types of materials are required. The procedures given above would be varied so that the tester says, for example: "How many matchboxes *do you think* would be required to cover the surface of this paper? Check with the matchboxes to see if you are right." For an acceptable response, the child gives his estimate expressed in the nominated units. As the child checks his estimate, the teacher will be able to judge if this estimate is reasonably accurate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. **Chooses a unit appropriate to the area of the surface to be measured.**	Small heaps of materials suitable for measuring units (one type of material only in each heap) For example: • lino-tiles 30 cm square • small uniform ceramic tiles (about 3 cm square) • playing cards • sheets of art paper	**PROCEDURE:** Show the child the heaps of different materials suitable for measuring units. Ask: "Which one of these could you use as units to find the area of . . . the table-top?" . . . this picture book?" . . . the hat-room?" . . . that wall chart?" . . . a small envelope?" On each occasion, ask: "Why did you choose that one?" The above constitute ten test items. **Acceptable Response:** The child names an appropriate unit. For example: • lino-tiles or sheets of art paper for the hat-room • ceramic tiles for the envelope or book • playing cards for the book or wall chart. In response to the question "Why did you choose that one?" he gives a response similar to one of the following: "You don't need as many of those to find the area." "You could cover the surface more quickly with lino tiles." "It would take too long to put playing cards on the hat-room floor." "You could count the sheets of paper easily." "The envelope is so small you need a small unit."

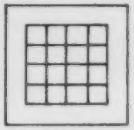
OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. **Finds shapes that tesselate to make a surface.** **Note:** The use of the word *tesselate* is not necessary for the tests; the words "fit together", or "fit together to make a surface" may be used.	Ten (or more) identical "tiles" of *each* of the following shapes: square oblong parallelogram irregular quadrilateral triangle pentagon hexagon octagon circle semi-circle **Note:** "Tiles" may be made of plastic, wood, strong cardboard, stiff paper, foam rubber or other suitable material. The size should be such that the ten can be arranged on the child's table.	**PROCEDURE:** Show the child the sets of "tiles", ten (or more) to a set. Say: "Take each set of 'tiles' in turn and fit them together to find out which shapes will make a surface (i.e. tesselate)." Repeat for each shape in turn, to give the required number of test items. Ensure that some of the shapes chosen do not tesselate. **Acceptable Response:** The child carries out the instruction with each of the shapes in turn, turning the "tiles" upside down where necessary to make them "fit". He then states that the squares, oblongs, parallelograms, quadrilaterals, triangles and hexagons will tesselate, and that the pentagons, octagons, circles and semi-circles will not tesselate. He may use his own words instead of the word "tesselate". **Note:** If the child places all the "tiles" from a set in one, or two, long rows, say: "Can you do it a different way?" or "Can you make a different shape?" in order to see if he can make a more compact surface. This will allow a better assessment of his ability to tesselate.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. Conserves area in terms of informal units.	Thirty-two identical square "tiles" made into two shapes: a square made of 16 "tiles" (four each way) An oblong made of two rows of eight "tiles"  Thirty-two identical square "tiles", made into two square shapes, each of sixteen "tiles".	i. **PROCEDURE:** Show the child the two shapes made from the "tiles". Ask: "Which of these has the greater area?" "Why do you think that?" Break up the arrangements and remake into two other shapes, each containing sixteen "tiles". Repeat, to give the required number of test items, on every occasion using different pairs of arrangements with sixteen "tiles" each. **Acceptable Response:** The child states on each occasion that both shapes have the same area, because they both contain the same number of squares. ii. **PROCEDURE:** Show the child the two squares each made of sixteen "tiles". Put one square in front of the child, one in front of the tester. Say: "This square is mine. That one is yours. They both have the same area. Make your square into another shape." "Which has the greater area now, your shape or mine?" "Why do you think that?" (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		"Make yours into another shape. Now which has the greater area, yours or mine?" "Why do you think that?" "I will make my square into another shape. Now whose shape has the greater area?" "Why?" **Note:** The rearranged shapes may be quite irregular in outline. For example:  All the above constitute one test item. There must be correct responses to each part for success in this Procedure. Only one test item is required. **Acceptable Response:** The child indicates his understanding of conservation by stating that each shape has an area of sixteen squares, and the two surfaces remain equal in area, no matter how they are re-arranged. iii. **PROCEDURE:** Show the child the two cards. Say: "These are two paddocks belonging to two different farmers. They are green because they are covered in green grass. Each farmer put four sheds on his pasture (paddock). The first farmer built them like this." (Place four cubes
	Two squares of centimetre graph paper each 4 cm by 4 cm, coloured green, and mounted on white card.	

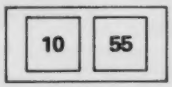
continued

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		on the grid, randomly scattered, none touching.) "The second farmer built his like this." (Place four cubes on the grid so that they touch, .)
	Eight cubes, each 1 cm x 1 cm x 1 cm (White rods are suitable. Centicubes may be used.)	Ask: "Which farmer has more grass left?" or "Which farmer's cows will have more grass to eat?" "Why do you think that?"
		Re-arrange the four "buildings" on each of the two "paddocks" to give different placements. Repeat the questions.
		Continue in this way, to give the required number of test items.
		Acceptable Response:
		The child indicates his understanding of conservation by stating that the grassed parts of both paddocks are the same in area no matter now the buildings are arranged or re-arranged, because on each occasion the buildings occupy four squares, and since the paddocks were originally equal in area, the area of the grassed parts will be equal.
Note: Understanding of conservation without use of informal units may also be tested.	A number of identical shapes (squares, oblongs or triangles) cut out of stiff paper.	iv. **PROCEDURE**:
		Take two of the paper shapes; ensure that the child understands that they are equal in area by superimposing one on the other. Put one shape aside as a "reference" shape. Cut the other into two pieces using a straight, curved or zig-zag cut. Arrange the two pieces apart, or to form a "new" shape.
		(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		Ask: "Is the area now the same as that of this first shape?" (Indiate the "reference" shape.) "Why do you think that?" Repeat, to give the required number of test items, using the other identical paper shapes, cutting into two pieces with different cuts, or into three pieces or four pieces. Repeat the questions on each occasion, to compare the area with the "reference" shape. **Acceptable Response:** The child indicates his understanding of conservation by stating that the area remains the same no matter how the surface is rearranged, since nothing is added or removed.
	Paper shapes (circle, square, oblong, triangle).	v. **PROCEDURE:** A similar activity is carried out, without using a "reference" shape. Take one of the shapes. Show it to the child. Cut into two pieces, and re-arrange. Ask: "Is the area the same as before?" "Why do you think that?" Repeat with other shapes and different cuts to give the required number of test items. **Acceptable Response:** As above. The child may "prove" the area is unchanged by reforming the original shape.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. Understands the time divisions of a day and relates these to daily activities.		**PROCEDURE:** Ask: "Is this day time or night time?" "Is it morning or afternoon now?" Say: "Tell me something we do in the morning." "Tell me something we do in the afternoon." "Tell me something you do at night." The above constitute five test items. If ten are required the questions may be repeated at different times of day. **Acceptable Response:** The child responds correctly to each question, and names activities that relate to the nominated times in such a way that the tester knows that the child understands the time divisions. If the child gives a response such as "play", "eat" or "skip", which could apply to any of the time divisions, the tester may be uncertain whether the child is referring to the specified time. In such a case say: "Tell me something that we do *only* in the morning (afternoon, night)." or "Tell me something *else* we do in the morning (afternoon, night)."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Tells the time from "traditional" and digital clocks, and relates times to daily events.** **Note:** Suggested order of presentation: a. o'clock b. half past c. quarter past d. quarter to e. five minute intervals past or to the hour.	A "traditional" clock or clock-face A digital clock (twelve hour)	i. **PROCEDURE:** Show the child the traditional clock. Set the hands at a selected time. Ask: "What is the time on the clock-face?" Repeat, to give the required number of test items at the desired level of difficulty, setting the hands at different times on each occasion. **Acceptable Response:** The child states the correct time. ii. **PROCEDURE:** Show the child the digital clock, or draw a digital clock-face, showing a selected time. e.g.  Say: "Read the time on the clock." ** Ask: "What does this mean?" If the time shown is past the half hour (for example 10.55), when the child has read the numerals, say: "Can you tell me this another way?"

** The test proper begins here.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. (continued)		Repeat, to give the required number of test items at the desired level of difficulty, showing different readings on each occasion. **Acceptable Response:** When the child reads the figures shown, for example, "ten fifty-five", he states that this means "fifty-five minutes past ten", and that the time can also be stated as "five (minutes) to eleven". iii. **PROCEDURE:** Repeat the procedure for i and/or ii, and when the child has stated the time given on the clock: Ask: "If this were daytime (night time), what might you be doing?" Repeat, to give the required number of test items, using other times within the selected level of difficulty. **Acceptable Response:** The child names activities appropriate for the time stated.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (a) Knows the days of the week, in sequence, (b) knows the months of the year in sequence, (c) uses a calendar, and (d) writes dates.		(a) i. **PROCEDURE:** Ask: "Can you tell me the days of the week in order?" "Can you do it starting at Wednesday?" "Can you do it starting at Saturday?" "What day comes after Thursday?" "What day comes before Monday?" If further test items are required, ask other similar questions, to give the required number. **Acceptable Response:** The child answers each question correctly. (b) **PROCEDURE:** Say: "Tell me the months of the year in order." Ask: "What comes after May?" "What comes after December?" "What comes before July?" "What comes before January?" If further test items are required, ask other similar questions, to give the required number of items.

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)		**Acceptable Response:** The child answers the question correctly.
	(c) A calendar Pencil and paper	(c) **PROCEDURE:** Give the child the calendar. Ask: "What year is that calendar for?" Say: "Show me to-day on the calendar." "Show me the 10th June. What day of the week is it?" Ask: "What is the date of the first Tuesday in March?" Say: "Say the dates of all the Sundays in January." "Find out how many days there are in November." Ask: "What is the sixth month?" Write on the chalkboard, "4th December,* 1977". Say: "Show me this day on the calendar." Write on the chalkboard "11.5.77*" (or "11.5.*1977"). Say: "Show me this day on the calendar." Ask: "What day of the week is Christmas Day this year?" The above constitute ten test items. If only five are required, a representative selection should be made.

* Write numerals for the current year instead of 1977.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. (continued)		**Acceptable Response:** The child answers the question correctly.
	(d) A calendar Pencil and paper	(d) **PROCEDURE:** Show the child the calendar. Give him the pencil and paper. Say: "Write today's date." "Write the date of next Monday." "Write the date of all the Saturdays in June." "If the next Infants' School Club meeting is the fourth Thursday of this month, write what the date will be." "Write this date another way: 6.7.1977*" "Write this date another way: 2nd February,*1977." If further test items are required, ask other similar questions, to give the required number of items. **Acceptable Response:** The child writes the date correctly.

* Write numerals for the current year instead of 1977.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. Understands elapsed time, and uses related vocabulary.		**PROCEDURE:**
		(a) Say: "If John runs around the playground and Bill walks, and they both start together, who will finish first? Why?"
Note: Related vocabulary: (a) fast/slow (b) old/new (c) old/young (d) early/late (e) before/after	(b) Two pictures, one of an old building and one of a new building, the age difference being quite obvious.	(b) Recall an old and a new building in the environment, or show the child the two pictures, one of an old building and one of a new building. Say: "Which building is old and which one is new?" "Why is that one older?"
	(c) A picture of a child, and a picture of an adult.	(c) Show the child the two pictures, one of a child and one of an adult. Say: "Which person is old and which one is young?" "Why is that one younger?"
		(d) Say: "The bus was due to arrive at nine o'clock, and it came at ten past nine (a quarter to ten, five to nine, nine fifteen, eight forty-five). Was the bus early or late? Why do you think that?"
	(e) A set of pictures (about five) each of which shows a stage in a sequence, e.g. getting ready for school.	(e) Spread out in front of the child the set of pictures, in a random arrangement. Say: "Put these in the right order." "Why did you put this one first and this one next? Why did you put this one next? Why did you put this one last?"
		The above constitute five test items. If ten are required five similar items may be devised, one each of the types a, b, c, d and e.

(Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. (continued)		**Acceptable Response:** The child answers the questions using appropriate words. In response to the question "Why . . . ?", the child gives answers similar to the following: (a) "Running is fast, walking is slow." "Running is faster than walking." "Walking is slow, running is fast." "Walking is slower than running." (b) "It was built first." "It has been up a longer time, so it's older." (c) "The child was born last, so he is younger." "The adult has lived longer, so he is older." (d) "The time it came is *before* the time set down, so it is early." "It came after it was supposed to, so it was late." "Ten past nine is later than nine o'clock." "Eight forty-five is earlier than nine o'clock." (e) "This happens before that." "You put on your socks before your shoes." "Waving goodbye is the last thing."

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. **Applies the knowledge of measurement of time, using standard units, to environmental situations.**	A clock or clock-face A calendar.	**PROCEDURE:** (a) Say: "When I left home to come to school the clock showed eight o'clock. When I got to school it showed nine o'clock. How long did it take me?" (b) Say: "I started writing a letter at eleven o'clock. It took me half an hour. Show me on the clock the time when I finished my letter." (c) Say: "Mum put the biscuits in the oven at ten forty-five. They took a quarter of an hour to cook. What time did she take them out?" (d) Say: "This was the time when Mary began her painting. This was the time when she finished." (Set the hands on the clock-face to show a quarter to twelve, then move them to show ten to twelve.) "How many minutes did the painting take?" (e) Say: "On Saturday Mum goes to work at seven thirty a.m. She comes home at noon. How long is she away from home?" (f) Say: "Today is 15th September and Mary's birthday is on this day (point to 20th September on the calendar). How many days to Mary's birthday?" (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		(g) Say: "How many weeks till the holidays?" (Ensure that the child knows the present date and the starting date of the holidays, and can find these on the calendar.) (h) Say: "Mummy is going for a holiday with Grandma. She will be away from the beginning of June to the end of July. How many months is that?" (i) Say: "We break up on the 26th August, and come back to school on the 12th September. Show me that on the calendar. How many days are we away from school?" (j) Say: "John is going to Melbourne on the 17th October. He will be away fifteen days. What will be the date of his return?" The above constitute ten test items. If only five are required use b, d, f, h and i. **Acceptable Response:** Using the clock or the calendar, the child answers correctly.
6. **Uses special vocabulary of time.**		

Procedures for assessing the understanding and use of special vocabulary of time, such as *second, minute, hour, calendar, date, week, month, year, midday, midnight, noon, afternoon, morning, evening, day, night, . . . ,* have not been included in these test items. Teachers should be able to discern familiarity with these terms without the use of specific tests.

MONEY

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Recognises coins.**	A collection of different Australian coins in current use, 1c, 2c, 5c, 10c, 20c, 50c.	i. **PROCEDURE**: Show the child one of the coins. Ask: "What is this coin?" Repeat, using each of the other five coins in random order, showing four of them twice, to give ten test items. **Acceptable Response**: The child names each coin correctly. ii. **PROCEDURE**: Place before the child the collection of coins, spread out randomly. Say: "Show me a two-cent coin." Repeat, naming other coins, to give the required number of test items. **Acceptable Response**: The child indicates the correct coin.

MONEY

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
2. **Knows the value of the coins.**	A collection of Australian coins of different denominations.	**PROCEDURE:** a. Place a large selection of the coins before the child. Ask: "Which coin is worth the most?" "Which coin is worth the least?" b. Ask: "How many one-cent coins equal this?" (Indicate a two-cent coin, five-cent, ten-cent, . . .) "How many two-cent coins equal this?" (Indicate the ten-cent coin, then the twenty-cent.) c. Show the child two different coins. Ask: "Could I buy more (less) with this, or with this?" d. Show the child a combination of coins, e.g. a ten-cent and a two-cent, or a five-cent, a two-cent and a one-cent coin. Say: "Show me this amount another way." e. Give the child all the coins. Ask: "Can you show me some different ways of making up twenty cents? Ten cents? Fifty cents? Five cents?" The above constitute five test items. If ten are required, each type, a, b, c, d, and e, may be repeated using other coins. **Acceptable Response:** The child indicates by his response that he understands the value of the coins.

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
3. **Counts coins to find the amount of money.**	A collection of various coins in current use.	**PROCEDURE**: Give the child a selection of coins whose total amount is within the range of (a) ten cents, (b) twenty cents, (c) fifty cents, (d) ninety-nine cents. Say: "Count these and tell me how much money there is." Repeat, using other selections of coins within the same range, to give the required number of test items. **Acceptable Response**: The child counts the coins, and states the total amount correctly. Where appropriate, the child may first sort the coins.
4. **Uses appropriate coins for purchasing.**	A collection of coins with which to make purchases. Objects with price tags. Amounts will be within the range of: a. ten cents b. twenty cents c. fifty cents d. ninety-nine cents.	**PROCEDURE**: Say: "This ---------- costs twelve cents. Show me the coins you would use to buy it." Show the child a price tag (within the selected range). Say: "Show me the coins you would use to buy this article." Repeat, using instructions of both types, to give the required number of test items for the selected range. (Continued over)

MONEY

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
4. (continued)		**Acceptable Response:** - The child selects coins to make up the designated amount. If the child selects an inappropriate number of smaller coins to make up the amount, say: "Can you make up the amount using fewer coins?" **Note:** For prices within the range of ten cents, it is less important that the child selects the fewest coins.
5. **(a) Understands the concept of change and (b) carries out shopping transactions.**	A collection of coins with which to carry out transactions. Objects and price tags Amounts will be within the range of: a. ten cents b. twenty cents c. fifty cents d. ninety-nine cents e. one dollar (after Objective 6.)	(a) **PROCEDURE:** Say: "You be the shop-keeper. I want to buy this lolly for fifteen cents. Here is my twenty cents." (Offer a twenty-cent coin.) Repeat, with suitable variations, to give the required number of test items, within the selected price range. **Acceptable Response:** The child gives the lolly and an amount of change. Provided that change is given, the response is acceptable even when the amount of change is incorrect. **Note:** The child may give the change by using a subtraction method, or the shop-keepers' method of "counting on."

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		(b) i. **PROCEDURE**: Say: "You be the shop-keeper. I want to buy this ---------- for eight cents. Here is my ten cents." Say: "You be the shop-keeper. I want to buy this ---------- for seven cents. Here is my five cents." Say: "You be the shop-keeper. I want to buy this ---------- for fifteen cents. Here is my money." (Give the child the correct amount.) Repeat using other similar shopping situations, involving from the child • no change, or • change, or • a request for more money, to give the required number of test items, within the selected range. **Acceptable Response**: The child carries out the transaction correctly, • giving the correct amount of change, or • requesting the required additional amount, or • recognising that the exact amount has been tendered. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
5. (continued)		**Note:** Change may be given using a subtraction method, or by "counting on", as shopkeepers do. The shopkeepers' method is quicker and more efficient, but the child will not know the actual amount of change given.
	ii. A selection of objects with the following price tags: a. 8c, 7c, 9c, 5c b. 15c, 12c, 17c, 20c c. 32c, 45c, 21c, 16c d. 98c, 33c, 76c, 84c A number of five-cent, ten-cent, twenty-cent and fifty-cent coins.	ii. **PROCEDURE:** Show the child all the objects with price tags. Give him the coins. Say: "I'll be the shop-keeper and you be the buyer. Which of these would you like to buy? Give me the money to buy it." Repeat, to give the required number of test items within the selected range. **Acceptable Response:** The child tenders an amount of money greater than or equal to the price. When change is given (by the tester) the child checks the amount to see that it is correct. **Note:** When a larger amount is tendered it should be the closest possible that can be made with the available coins. Thus, if the cost of the article is forty-six cents, then fifty cents should be tendered rather than, for example, ninety cents.
6. **Recognises the dollar note and the two-dollar note.**	A one-dollar note A two-dollar note	**PROCEDURE:** Show the child one of the notes. Ask: "What is this note?" Show the child the other note. Ask: "What is this note?"

Continued

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
6. (continued)		Place the two notes before the child. Say: "Show me the dollar note." "Show me the two-dollar note." The above are the only test items for this objective. **Acceptable Response:** The child names *each* of the notes correctly. He indicates the correct note on *both* occasions.
7. **Reads and uses symbols for recording amounts.**	Price tags with amounts within the following ranges: a. 8c, 7c, 9c, 5c b. 15c, 12c, 17c, 20c c. 32c, 45c, 21c 16c d. 98c, 33c, 76c, 84c e. over $1 and under $20 Paper and pencil A collection of coins for the child to count.	**PROCEDURE:** • Show the child, one at a time, the price tags within the selected range. Say: "Read this." • Give the child pencil and paper. Name an amount within the selected range, for example fifty-five cents, one dollar fifty cents, . . . Say: "Write this amount." • Give the child a selection of coins. Say: "Count these and write down the amount. (Continued over)

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
7. (continued)		Repeat the activities, reading other price tags, writing other amounts from dictation, and recording the totals of other selections of coins, to give the required number of test items within the selected range. **Acceptable Response:** The child reads the amounts on the price tags correctly. He writes the amounts, using numerals and the symbols c and $. **Note:** If the child attempts to write the amounts in words, ensure that he understands that numerals and symbols are required.
8. **Understands the need for money.**		**PROCEDURE:** Ask: "Why do people need money?" or "Why is money used?" or "What would happen if there was no money?" **Acceptable Response:** The child indicates in his answer that he knows that money is used for buying and selling, and that without money a cumbersome barter system would have to be used.

TEMPERATURE

OBJECTIVES. The Child . . .	TEST MATERIALS	TEST PROCEDURES and COMMENTS.
1. **Recognises differences in temperature.**		The child's recognition of differences and changes in temperature can be assessed in the classroom as he discusses and answers questions about • the weather • the seasons • the time of day • his clothing • his physical reaction to heat and cold • visits to places with different climates • science experiments • reading thermometers.
2. **Uses vocabulary related to temperature.**		From observations as the child takes part in activities as in 1 above, the teacher will note familiarity with vocabulary such as hot, cold, warm, warmer, thermometer, degrees, . . .
3. **Applies knowledge in environmental situations.**		The child's skill in applying knowledge of temperature in the environment can be observed in the classroom as he engages in activities such as • making weather records and charts • making graphs involving temperature (See Number, Objective 40.)

APPENDIX

OUTLINE OF TRIALLING.

FEEDBACK

This series of goals or objectives, together with the lists of activities for assessing a child's grasp of knowledge, skills or understandings in each, were devised and set down in the first instance by the members of the North Sydney Region Infants' Mistresses' Council Committee, and a draft document was produced based on this work. The text of this document has subsequently been extended, modified or otherwise amended in response to feed-back organised by the Committee in order to involve teachers, and others interested in teaching procedures, in assessment of the usefulness and practicability of the tests.

Feedback was organised to come from seven sources. These were:

1. Trialling of the test procedures in schools.
2. Discussions with trialling teachers in in-service groups.
3. Comments from users in the form of annotations written in the trialling documents concerning the text of the document.
4. Responses to Questionnaires returned from all those taking part in the initial testing.
5. Perusal of children's Response Sheets sent to the Committee after testing.
6. Assignments written by C.A.E. mathematics students in their third year of training.
7. Comments by and discussions with mathematicians, academics, college lecturers, and others interested in this aspect of education.

Below is an account of the planning and results for each of the seven sources of communication.

1. **Trialling of the test procedures in schools.**
   (Findings from this trialling came to the Committee by means of 2, 3, 4 and 5 in the list. See below for detailed discussion of each aspect.)

   The tests were trialled in 42 schools or departments, with 136 teachers, which involved at least 4,000 children to choose from, and 544 actually tested.

   Not all the children tested of course were experiencing failure; a number of average and above average achievers were included by teachers so that they could familiarise themselves with the methods of testing.

   At the N.S.R.I.M.C. meeting in 3rd term 1977 mistresses present were asked to indicate their willingness to take part in the trialling scheme and to commit their schools to participate in the project. They were asked also to ascertain if the Primary Department of their school would be willing to co-operate, with teachers of years 3 and 4, and if so to inform the committee.

   Following this, three categories of schools were selected, to follow somewhat different programmes and schedules:

   I. Schools with small infants' departments; all infants' staff to participate.
   II. Larger infants' departments where one teacher from each grade, K - 2, would participate.
   III. Infants' and Primary Departments where one teacher from each grade, K - 4, would participate.

   At a subsequent meeting of mathematics advisers, lecturers and co-ordinators, a further category was added following an offer by Dr. R. Perry of Mitchell College of Advanced Education. This was:

   IV. Small schools in the Bathurst area.

   Trialling teachers of schools in categories I and II were to be given some in-school familiarization of the document before beginning testing. In category I this was whole-staff discussion and whole-staff involvement. In category II it was individual discussion between teacher and mistress. Trialling

teachers in categories III and IV were to be given only a brief letter of explanation and were to familiarize themselves with the procedures from the book alone.

Principals and Mistresses of the schools in the first two categories were to be invited to an Inservice course at which explanations were given so that they could conduct the familiarization procedures in their own schools and departments.

Inservice discussions were planned for other teachers taking part so that they could discuss their progress with the committee members during the course of their trialling.

When all work from the schools was collated the information was evaluated. It was found that there was very little difference in results from categories I, II and III. However, of those small schools which took part, the teachers had somewhat different findings from the other categories. Most said they found the tests to be both unnecessary to themselves, and uninteresting to the children. Since there were so few of them (7) and so many of the others (129) it would seem that their reaction may be due to isolation, unfamiliarity with the activities used in larger schools and classes, and to pressures of workload and time. It would not be possible to state whether their responses would be characteristic of other small school situations.

In general, the over-all reactions from those taking part seemed to be:

(a) Teachers recognised the need for such a series,
(b) they found the sequence useful,
(c) they indicated that the instructions generally were clear, and the tests easy to follow and to administer,
(d) they found that planning and time factors caused the greatest problems,
(e) they located and pointed out areas where they found difficulty or ambiguity in giving, marking or interpreting tests.

The particular and detailed findings of their trialling were indicated in comments which were written on the document pages, in answers to the questionnaires and in response to personal discussions at the inservice courses, all of which are discussed in detail below.

2. **Inservice Discussions.**

When trialling had been in progress for some time, the special inservice courses which had been planned were held; at these the trialling teachers met and discussed their work with committee members.

The schedule of these meetings was as follows:

1st March, 1978. Principals and mistresses of city schools taking part in the trialling were invited to Naremburn Inservice Centre. At this meeting it was explained that use of the trialling book was to be evaluated under varied conditions where teachers had different degrees of guidance. In some schools the teacher would be given the book with a request that he/she use it after individual reading of the text; in some schools teacher and supervisor would discuss the text and plan the procedures; in others there would be whole-staff discussion and planning. It was explained that reaction from teachers working under these different conditions was necessary because it was felt that the book in its final form would be purchased and used by

- individual teachers who felt a need to assist children in their own classes;
- principals or mistresses who wished to initiate a school programme of help for all children with difficulties.

The book therefore must be useful to and understood by teachers working alone, and also those working together in a whole-school context.

The necessary number of trialling books was given out and signed for, so that an accurate recording of returns could be kept.

The role of the principal or mistress in initiating and monitoring the programme in the school according to the category in which it was placed was explained, and the follow-up (inservice for teachers, questionnaires, return of document, etc.) outlined.

17th April, 1978. Teachers of schools in Category I and Category II who were to carry out the tests were invited to attend. Discussion of the document was held and the role of the teacher explained. Very little testing had actually taken place at this stage. Kindergarten teachers did not attend this meeting as it was felt it was too early in the year for them either to leave new entrants or to begin assessments of these children's difficulties.

6th July, 1978. Teachers in Category III were invited to attend discussions. These teachers had had no staff discussions at their school. They came to talk about their involvement, their introduction to the document, their reactions, their difficulties and their test experiences to date.

19th July, 1978. Kindergarten teachers from the Category I and Category II schools were invited. Their pupils were now integrated in the schools and they were able to assess the usefulness of the early tests in relation to these five-year old children.

At all these meetings teachers discussed their findings, reactions, difficulties and misunderstandings. They told of their methods, materials, failures and successes. They found mistakes and misprints. They criticised weaknesses, indicated strengths, suggested modifications, recounted individual experiences and outlined school plans or policies with regard to testing, assessing or helping pupils.

Notes were made of all the discussion points.

Resulting from these discussions, a number of changes were made. These were mainly as outlined below.

- Extra **Notes** of explanation were provided.
- Some instructions were set out in greater detail.
- Additional procedures were included where it was felt that activities had been overlooked or understandings not catered for.
- Definitions were provided where it was felt these added to the clarity of the explanations (e.g. "oblong").
- Ambiguities were removed by using more definite sentence structures.
- Additional examples were provided where it was felt these assisted teachers. Sometimes further diagrams were included.
- The text was broken or rearranged for easier reading.
- Explanations of the rationale were expanded.

3. **Annotations in the Trialling Document.**

Teachers trialling the procedures were each given one of the documents, with instructions that it must be returned to the committee on a specified date and that any comments on the text or tests would be welcomed.

Comments were asked for on the following:

The format of the document;
the wording of the instructions or questions;
the descriptions of the test procedures;
the availability of certain test materials;

the ease (or otherwise) of construction of other test materials;
the comprehensiveness of the tests;
the reactions or replies of children;
the adaptations of wording used by the tester;
the non-provision, or further provision, of test items;
any difficulties or ambiguities encountered;
any mistakes, omissions or misprints;
any other matters which the tester would like to mention.

Teachers were asked to write their suggestions and comments on the "facing" pages of the book wherever appropriate, and to list on the cover the page numbers of the text where comments were made.

The dates for the return of the trialling documents varied according to the category in which the user's school was placed.

There was 100% return of books. Each was "marked off" a master list as it was received back by the committee.

The committee studied and evaluated the comments written for each batch of books as they were received. Some of the books had very few textual comments; these generally contained case histories or quoted children's answers (either amusing or inconclusive). Others found misprints and inconsistencies. Many suggested better wording or gave examples of their own changes to the suggested words. Some books contained masses of comment, some very few. Often a pertinent comment came from a book with very few annotations. Great interest in and careful perusal of the document was evidenced by the detailed and wide-ranging nature of the annotations. The length of service of the teacher did not seem to have any particular bearing on the nature of the comments, except that teachers with the least number of years of service generally made more sweeping statements.

The comments were in general similar to, but more detailed than, those noted from the inservice courses, and the resulting changes were of the same nature, i.e. extra Notes, expanded instructions, additional procedures, and specific definitions.

4. **Responses to Questionnaires.**

Questionnaires were sent ot all the teachers in each category; in the response forms schools were named, but the individual teacher was not identified. The questions were set out under three headings: **Interpretation of Text, Administration of Tests**, and **General.** These Questionnaires were given out, and returned, at different times according to the Category in which the teacher's school was placed. Relevant comments from these were extracted and findings collated.

Questions on the interpretation of the text were answered in detail, also those on administration. Those on the general section were not so productive of comment.

An analysis of the individual questions indicated fairly general agreement in most sections. An indication of the types of responses is given.

The first set of questions concerned Interpretation of the Text.

> *What was your reaction to the whole document on first reading? Why?*
> Nearly all the respondents expressed horror, amazement or shock at the thickness of the volume. (In its trialling form, its measurements were 31cm x 25cm x 4.5cm.)
>
> *Did your reaction change later? If so, why?*
> Nearly all changed their reactions when they actually examined the contents and discovered the purpose of the tests and their comprehensiveness, and realised that they did not have to read it all nor administer all the tests, nor involve all the children.

How clear did you find the explanations in the introductory statements concerning

(a) *Rationale?*
Nobody expressed any difficulty with this section.

(b) *Recording?*
Nearly all found the explanations quite clear – one or two did not see the necessity for extensions of the code beyond ✓ and ✗.

Were you able to understand

(a) *The purpose of the tests from the Objectives stated?*
All seemed able to understand the purpose although a few did not agree with the necessity for carrying out the tests (as they knew what the tests would reveal without having to give them).

(b) *The language used in describing the test procedures?*
There were no adverse comments, indeed no very specific comments.

(c) *The language used in setting out the Acceptable Responses from the child?*
All seemed to find this clear and easily comprehended. A few suggested a bolder kind of print for clarity or for catching the eye.

Was there much need to adapt the wording in the test items to suit individual children, or to clarify their responses to the test questions?
Many teachers admitted to changing the wording either to agree with their own mode of presentation or because the suggested mathematical language had not been taught. Many of the changes recorded were not significant.

Did you find the format of the suggested Child's Response Sheet easy to follow?
Nobody suggested that the format of the sheet was hard to follow.

Did you find it difficult to record the Objectives briefly on the Child's Response Sheet by using "Key-Words"?
Only one person found it difficult to select Key-words. This person wanted a suitable list published.

Did you find the marking code adequate?
Most triallers found the code suitable; a few still preferred just ✓ and ✗.

Have you any other comments concerning the interpretation of the whole document, or parts of it?
No significant comments emerged, in fact very few teachers answered this question.

The second set of questions concerned Administration of the Tests.

Before beginning testing, what familiarization procedures were adopted? (Independent reading of document? Individual discussion with mistress/principal? Whole-staff involvement? Other?)
Most teachers outlined the procedures used in their schools; these followed those suggested by the categories of their placement. However a surprising variety of instructions was given to teachers in Category I, in spite of the fact that the principals and mistresses all received the same briefing.

What classroom organization was required for administering the tests?
Teachers outlined their strategies for finding time to test. These included team-teaching, withdrawal, relief by mistress, and utilization of library, assembly, play, scripture or resource periods. They described the advantages and disadvantages of each. Some used group-work situations, but commented on the adverse effect of distraction.

How were children selected for diagnostic testing? (Low marks? Constant failure? Lack of progress? New pupil? Other?)
All the above were used.

Were average and bright children tested in order to gain familiarity with the test procedures? Was this beneficial?
Many selected bright and average children so that they themselves could learn the test procedures.

How long (in general) did you spend with each child before arriving at a diagnosis?
Comments varied concerning the length of time taken. Sometimes, particularly where a child was tested in the afternoons, fatigue caused a postponement. A few took as little as ten minutes, some about an hour. The general average seemed to be 20 - 25 minutes. Tests in measurement took longer. When students tested, they found many procedures could not be given, as the work had not previously been treated in the classroom.

How many Objectives (in general) had to be tested before arriving at a diagnosis?
The usual response was four, or five, once a starting point was decided upon. Occasionally teachers started at the beginning as a matter of course, but usually "early" starting points were for the purpose of winning a child's confidence and ensuring that he was comfortable in the situation.

How did you select the objective at which to commence testing a child? At the level of the rest of the class? At the level of a suspected weakness? At the beginning or at a level too easy, to ensure confidence?
Answers spread over the three methods fairly evenly.

How successful was your method of selection?
Most teachers seemed satisfied with their selection.

Was there an Objective in which a number of the children you tested continually failed in the test items? Can you suggest a reason for this common failure? (Not taught? Difficult concept? Other?)
Most teachers did not find such an objective. Those who did, indicated (a) they had not taught the subject matter or (b) the test was beyond the child's grade level.

Were the test materials suggested readily available or easily made, and suitable for the purpose?
Most teachers agreed that the materials were in general easily found in schoolrooms. Difficulties were mainly with the beam balance. (A suitable, accurate balance is difficult to obtain commercially even from educational stores.) Teachers' aides were often employed advantageously in assembling, organising or manufacturing equipment.

Have you any other other comments concerning the administration of the tests?
Very few teachers responded to this; those who did re-iterated the difficulty of arranging time slots or finding quiet places for testing.

(Mistress/Principal to answer.) When you re-tested a child previously tested, in order to ascertain reliability of test procedures, were your results similar?
Most agreed that the results were similar if the re-test was given a short time after the previous test before further learning took place. In a few instances the results were better perhaps because of the previous test experience, or increased confidence, or the greater skill of the tester.

(Mistress/Principal to answer.) How would the results of this test be useful to you in school organization? (Class placements? Disciplinary policies? Work of resource teachers? Purchase of

equipment? Other?)
Most replied that the chief benefits were in curriculum planning, in programme making, in understanding children's needs and in highlighting equipment needed for activities.

The final set of questions was of a General nature.

Do you consider that test series such as this are necessary? Useful?
Most respondents considered the tests useful in that they enabled teachers to understand and help pupils. The list of ordered objectives helped them evaluate their teaching sequences.

Did you find the knowledge gained from the testing valuable to you in terms of

(a) *your understanding of the child?* Many did not respond; of those who did a number said they already understood their pupils well enough not to need any tests for this purpose. Others said they gained insights into the child's thinking not possible before (and not only mathematical insights).

(b) *advantages or benefits for the child?* There were not many replies to this; those who answered said that the child gained confidence and importance from the testing situation, and established a better relationship with his teacher.

This series of tests is based on evaluation of stated objectives. Do you feel "comfortable" with this approach?
All except one of those who replied said they felt comfortable with this approach. No reason was given for the exception.

If not, what approach would you consider more appropriate?
No other approaches were mentioned or suggested here. In other papers received, a few suggestions were offered for shorter screening tests.

After arriving at a diagnosis from study of a child's Response Sheet, were you able to arrive at a conclusion about the child's level of achievement, or his difficulties?
All those who replied (about ¾ of those received) had no difficulty, and this was borne out by the detailed diagnosis statements on the Response Sheets.

Were you able to make a decision in each case about the kind of follow-up work required?
All those who diagnosed the difficulties said they were able to suggest a suitable follow-up programme. This also was borne out by the detailed follow-up plans written on the Response Sheets.

The responses from the Questionnaire led to some changes in the text of the document. Further ambiguities in the tests were discovered and corrected. A few omissions in sequence came to light and were corrected. Wherever a teacher's misunderstanding was shown to have arisen from a too brief statement in the text this statement was expanded. Occasionally it was felt that further explanation was needed in the Introduction; additional paragraphs were inserted to cover points raised.

5. **Children's Response Sheets**

At the end of the trialling period for each category, the children's Response Sheets were returned with the annotated Trialling Document. These Response Sheets were scrutinized both as to the use of the marking code and the teacher's comments on the tests. The diagnosis recorded, and the follow-up suggested, where included, were also studied for information on teachers' attitudes and findings.

The Response Sheets received showed

by the ticks and crosses that the testers had carried out the procedures faithfully, and the comments on the children's performances further revealed the teachers' careful observation of the children as they made their responses. The Committee realised from scrutiny of these Response Sheets from anonymous children how vital the comments column is for expanding or interpreting the verdict of the ticks and crosses.

The type of class in which the child was placed (e.g. parallel, graded, ...) did not appear to have any bearing on the general results, nor did the length of the teacher's experience. In all cases the child was tested by his own teacher, except where the mistress re-tested, or a student carried out an assignment.

No teacher, apparently, had difficulty in finding keywords. Although these varied considerably all were appropriate, and easily led to the recall of the complete statement of the objective.

Excellent diagnostic statements were made, and where follow-up was indicated this was appropriate and thoroughly planned. No useful modifications were suggested. One person suggested that complete objectives, together with keywords, should be printed in a blank book format. For obvious reasons this is impractical and wasteful – a whole book is not needed to record tests for about half a dozen or so objectives at a particular level. The suggestion that pads of blank response-sheets could be made is much more sensible and useful.

6. **College Students' Assignments.**

Two Colleges of Advanced Education (Alexander Mackie C.A.E., and Sydney Teachers' College) were involved and seventy-five College students took part in the trialling – all had had sufficient training to be aware of the concepts and activities involved and to be competent in organising them. Students of S.T.C. trialled the Measurement section and of Alexander Mackie C.A.E. the Number section. Activities they carried out were narrated in detailed form, and their findings set out at length.

The assignments of the College students, which included their written statements, their questionnaires and response sheets, were sent on to the Committee. These gave new insights into the trialling from a different point of view because of the students' youthful enthusiasm, literal approach to instructions and complete honesty in judgement. They were not dulled by years of routine expectations. They took their mathematics and their theory of teaching seriously, and they had no "axe to grind" in stating their verdicts, since the children they tested were not the children they had taught (or were supposed to have taught). They practised in a range of school types from inner city to affluent outer suburbs and they included migrant children in their samples.

Aspects emerged which were different from those noted by established teachers in schools.

The students' comments revealed certain attitudes amongst class teachers (e.g. a definite bias against certain strands), and also showed the Committee variations and differing interpretations possible in the instructions for certain procedures.

Notes of explanation on evaluation policy and purpose were added because of some of their comments. Where instructions were found to be inexact these were rewritten.

7. **Comments from Academics.**

Two meetings were held with academics involved in mathematics education, one before the trialling period and one after its conclusion. Some of these people had taken part in trialling procedures of their own in the intervening period. At both these meetings relevant comments were noted for later assessment and possible inclusion

in the revised document. Comments from the second of these meetings were particularly numerous. In addition, "review" copies of the document were sent to other academics too far away to attend; some of these people returned written comments, which were studied and noted by the committee.

Letters from academics, mathematics lecturers, inspectors, mistresses and class teachers were also received and considered. The comments from all these sources were most valuable and led to many alterations, ensuring greater clarity, consistency and mathematical accuracy in the text.

Discussion Points – definitions.

Some matters raised but not acted upon were from people living outside N.S.W. (sometimes outside Australia) and obviously working from a different syllabus. Since the tests are not designed to find the mathematically mature, but are to assist those who are failing in what they have been taught, the syllabus from which the children have worked has a bearing on the tests given, and where a different syllabus is involved, modifications would have to be made. The following matters are of this type.

* *Zero and nought, rectangle and oblong.* These terms relate to convention or definition. The definitions followed here are those stated in the present N.S.W. syllabus of mathematics.

* *Mass and Weight.* In N.S.W. there is an attempt to show the distinction between these, and to use the word "mass" correctly in the early stages, so that *later* the word "weight" may be understood.

* *Rod action for subtraction.* Test procedures are based on the N.S.W. method of representing this operation (one rod covering all or part of another). Where some other system of rod representation is used with Cuisenaire (or other) rods, modifications would have to be made.

* *Graphs: use of a base line.* Children in N.S.W. are taught, and expected to use, line graphs only (not "pie" or other area graphs); they are shown the base line to allow for easy interpretation, and to lead on to the notion of the two axes. While it would be possible to construct a legitimate line graph without a base line, it would be very difficult for a child to interpret or find other information from it. But in any case the purpose of the test is to find where a child is failing with what he has been taught (if he has been taught) and is not to discover the creative or innovative child.

* *The word "train" to describe a line of rods all of the same colour.* The rod vocabulary used in N.S.W. Department of Education publications is used in this book. Adaptations may be made if other terms are used.

Discussion Points – rationale

Other points were brought up, involving policies and underlying principles.

All are of a general nature and are the result of the careful, interested, detailed appraisal of the reviewers of the document. The committee members were grateful for the opportunity to consider and discuss these matters. After due deliberation it was decided to make no alteration to the text either in explanations as already given or procedures as already described, other than to indicate here the matters which were discussed and the committee's attitude to them.

* *That there is too much emphasis on sets.*
  It is pointed out that there is no emphasis on sets for the sake of sets, as in Set Theory, merely an emphasis on *things* as they group and re-group in the environment. The language used in connection with sets is the most efficient way of describing these actions. See page 23.

* *That there is the possibility that teachers may give children the rod tests even though they have not worked with*

rods, thus causing trauma or disadvantage to the children.
The intended application of the tests is clearly stated. The purpose is to discover whether the children understand the work they have been doing with rods and how it is related to the environment. If children who have no knowledge of rods are given the tests, the results will merely confirm this.

* *That there are no tests of attitudes.*
It was felt that specific tests of attitudes (supposing the committee could devise them) would not be of great use for classroom teachers. Comments from trialling teachers highlighted the fact that the one-to-one face-to-face situation did in fact reveal a great deal about attitudes that was extremely useful to the teacher in less obvious and more subtle ways, and led to modifications in the way a child was managed in class.

* *That the complete series of tests is long, and that shorter samplings of the Objectives could be given, which would either give a quick idea of a child's progress, or act as a screening device.*
It is again stressed that the tests are not designed to find out *who* is failing. They are designed to be used with a child who is known to be failing, to find out *where* he is failing, and possibly even *why* he is failing. To find the particular detail in which a child fails will require detailed tests.

* *That some of the Objectives are not set down in the correct order.* (A variety of suggestions for correcting or improving the order was given, e.g. 6 after 9, 15 before 7.)

It was stated in the introductory notes that the Objectives are not listed in strictly hierarchical order, because it is impossible to arrive at such an order, and in any case all children do not progress through the Objectives in an identical order.

* *That the term "number sentence" be replaced.*
(It was suggested that the terms "number story" or "equation" be substituted.)

The term "number sentence" is that used and recommended in the N.S.W. mathematics syllabus. "Number story" is unsatisfactory as it could be either a childish substitute for a correct term, or an ambiguous variant to describe the problem narrative. "Equation" could not include the use of "greater than", "less than" and "is not equal to" in describing number relationships.

* *That only certain fractions should be included, e.g. halves, quarters, thirds, and that all others should be excluded or reserved for "advanced" children.*
Ideally, if a child understands the concept of fractions as such, the number of "parts" does not materially affect the relative difficulty of the different fractions. By including tests of each category of fractions the teacher may ascertain whether the child understands the whole concept, or whether only certain common fractions are known. A decision can then be made as to the desirability of working with other fractions, based on the degree of maturity of the child, or on the use such knowledge will be to him.

* *That topics are included which are only suitable for "able" or "advanced" children.*
It is not intended that children be given tests of work beyond that suited for their grade level, nor is it intended that the tests be used to find, or extend, "able" and "advanced" children. The work as set down forms part of a learning sequence. It must be remembered that topics suitable for "advanced" children in one grade, may be (and usually are) the topics for the "average" children in the next grade. Hence it is not possible to state in the descriptions of the procedures whether they are suitable for "advanced" children only, unless age and grade are also to be specified for each procedure. Since the tests are designed so that the tester may follow *the progress of an individual child* it would be undesirable to state definite grade levels. (The suggestions

which are given on page 16 are suggestions only but are designed to protect young children against being subjected to tests designed for older children.)

* *That the tests take too long to administer.*
It has been admitted that one-to-one tests are time-consuming, but this cannot be avoided if a child needs individual help; however this is a small price to pay if it means that the success of a child's mathematical future is thereby assured. One commentator complained that it took 35 minutes to give nine tests! This appears to the committee to be very speedy testing indeed! Time taken in diagnostic testing *now* should save much time in *future* remedial planning, teaching and testing.

* *That the language of the tests should be standardised to help teachers.* (This was so that teachers when making adaptations to the text do not "cue" children by suggesting an answer.)

  Adequate notes regarding prompting are included. (See page 21.) It is felt that standardization would be most undesirable when the object is to probe the degree of understanding in individual children. An experienced teacher free to adapt the wording of the various procedures may be able to identify a number of intermediate levels of understanding or achievement.

  Standardization of language is only necessary when comparison of results is to be carried out. This is *not* the purpose of these tests.

* *That because there are so many tests, set out in so much detail, teachers will go into a state of "quantity shock" when presented with the total array of testing procedures.*
If teachers feel that they have to administer all the tests, or that a child has to be subjected to all the tests, such a reaction would be justified. When teachers realise that the quantity is there to allow for a better *selection* to be made of suitable tests for a particular child, then the state of shock should disappear. This has already been covered in the introductory notes.

* *That teachers may not be clear as to the focus of importance in Objective 1; is it Attributes in general, or is it certain attributes only (as specified in the description) or is it knowledge of the vocabulary employed in designating the attributes (e.g. the words "blue", "rough", "round" etc.)?*

  Actually there are three levels to be discerned in this Objective.

  i. *All objects,* animate and inanimate, have certain properties or characteristics which we call attributes. The Objective is designed in the first instance to ascertain if the child is aware of this (that all objects have attributes), and also of the fact that a whole range of attributes exists which can be applied (when appropriate) to the objects he sees around him. (A particular attribute can be applied to a number of different objects, e.g. wooden spoon, wooden box, wooden block.)

  ii. Since obviously the whole range of possible attributes cannot be taught and tested, it is necessary that a selection be made; it is reasonable that the attributes chosen are those most useful for the child's present and future studies (e.g. those of colour, shape, size).

  iii. Such properties or characteristics must be *recognised* by the child. They are *described* in words (which are usually adjectives, or adjectival phrases). For our "normal" children (i.e. not deaf, blind or mute) recognition of attributes involves also knowledge of the relevant vocabulary with which we discuss such attributes. Hence the test must be conducted using these words, and the child's understanding must be judged from his knowledge of them. In this sense the test is a test of the understanding of certain attribute-words.

* *That a "standard card index system"*

would be preferable to the whole-book system of presenting the tests. (The advantages suggested were (i) the handicap of book size would be overcome, (ii) each test would be on one card (perhaps colour coded), obviating the difficulty in administration caused by turning over pages, and (iii) kits of materials for the various tests could be assembled and packaged within the school, and the relevant cards for testing could be stored with the particular kits of materials.)

Teachers in discussion expressed a preference for keeping the tests in one volume, to prevent loss and facilitate review. The use of separate cards would increase the likelihood of loss, which causes a lack of continuity, and would destroy the possibility of frequent over-all review. Availability of the tests in "card" form as a sole presentation would thus be undesirable. But if used as a supplementary aid the idea has much merit. When materials for a test, or series of tests, have been assembled it is time-saving and economical if these can be kept together for future use. Perhaps indexed stackable containers could be used. Teachers can add to the value of such kits by filing with each kit sets of cards containing the relevant tests for that kit (one test per card).

* *That the book should not be disseminated without prior inservice training.* (This was so that there should be no abuse in using or interpreting the tests.)

The purpose of trialling the tests in a variety of types of schools, and using teachers who have been given a variety of degrees of guidance was to ascertain whether teachers could undestand the purpose and language of the tests from the text alone and could administer and evaluate the tests in the way intended, without other assistance.

All the oral and written responses from the trialling teachers would seem to indicate that they could. Where there were difficulties in the initial writing these have been, as far as possible, eliminated following teachers' comments during the period that the document has been progressively revised and retrialled. The committee feels that although in-school and in-service guidance are most helpful, any intelligent, caring, resourceful teacher can use the document unaided. It is intended that the first edition of the book be used primarily by teachers in the North Sydney Region of N.S.W., and that this further trial may lead to additional revision, if necessary.

* *That with children for whom English is a second language the book may cause difficulties.*
This was discussed at length. It was recognised that there are difficulties with these children in schools. The following points emerged.

  - The tests may indicate whether the child's difficulty is one of language only, or of mathematics only, or of both language *and* mathematics.
  - The format and suggested procedures may give guidance as to the type of English words which could be included in a language programme.
  - Where a child has too little English for valid testing, translation into his own language would be necessary before any assessment could take place; the tests however provide the subject matter to be translated.
  - It is desirable that a teacher give the tests; a parent unless previously a teacher could not interpret the responses. A bi-lingual parent could however work in conjunction with the teacher, translating the questions and the responses, to allow the teacher to assess the child's level of *mathematical* understanding.

* *That the Geometry section is very limited, nothing is included on direction, position, orientation, scale, etc.*
The committee members found it strange that while a number of critics considered that some topics were only

suitable for "advanced" children and so should not have been included (e.g. fractions other than halves, quarters and thirds; "difficult" vocabulary; certain types of number sentence such as $\square = 9 - 6$) others suggested new and different topics for inclusion. Some of the topics nominated, it is agreed, would provide fascinating activities for children. However since the tests are designed to help children who fail in given work on prescribed topics, the committee felt they could not include innovative subjects which very few teachers would have presented. The most that could be done here was to indicate and test ways in which prescribed topics could be developed and extended to give children greater understanding of their work, for example in the properties of plane figures, or in the interpretation of graphs. The non-inclusion of tests for any particular mathematical topic does not of course indicate that an innovative teacher should not develop a course for children in that topic.

* *That regular recording of "success" or "failure" is not good psychology.* (It is not clear whether this refers to the effect on teachers or children!)

Whether or not it is good psychology, it is necessary for a teacher to know when a child is failing in certain aspects of his work, and to find out where and why he fails. To do this certain tests are given, in some of which he will succeed and in some of which he will fail. When the teacher knows those in which he fails she can attempt to diagnose the reasons for such failure and plan learning or remedial programmes to ensure future success. It is not intended that the child should be aware of the number of his successes and failures or even that his responses are being labelled in this way. (All that he should realise is that his teacher is endeavouring to *help* him.) That this procedure of recording successes and failures should become *regular* for a particular child is certainly not envisaged. If the teacher is helped by the substitution of phrases such as "competent"/"not competent" or "understands"/"does not understand", or even "successful"/"is not successful" then of course these may be used instead.

* *That the length of the descriptions of test procedures and acceptable responses should be greatly shortened.*
This suggestion was made by several reviewers and was considered carefully by the committee while the document was being progressively amended. In each case the comment came from an educationist not now working in the classroom. Although practising teachers found the document lengthy, not one teacher asked that the descriptions generally be shortened, nor did any teacher point out how a particular procedure could be stated more briefly.

In nearly every case where the committee members found an ambiguity, a misinterpretation or an uncertainty in interpretation an analysis of the situation showed that it resulted from the brevity of a description of procedure or material or response and that the difficulty could be avoided by giving more detail in each sentence or adding further sentences. At discussion sessions teachers asked questions about words and phrases causing difficulty of interpretation, and asked that these be expanded so as to avoid these difficulties. Teachers did not like instructions such as "Continue in the same manner using similar material", or "Proceed as described above for the previous activity", or "Ask similar questions for the other objects, sometimes substituting *longer* for *shorter*". They asked that in statements like the first, the manner and the material be set out; that in statements like the second, the procedures be written in full again so that there would be no turning back of pages; and that in statements like the third, the questions with their substitutions be actually listed. Where considered advisable, this was done.

The descriptions of material sometimes caused trouble if briefly stated. When materials were listed as "two equivalent

sets of objects" teachers asked that the range (e.g. 1 - 10 or 1 - 20) be given, and asked whether the sets were to be arranged so as to show their equivalence, or were to be in random array.

If a child was to be asked "Is this longer or shorter? How do you know?" teachers asked for a fuller statement of the Acceptable Response than "the child responds correctly", and requested an explanation as to whether the response if correct was to be given one tick or two.

In all such cases the relevant sentences had to be expanded, or further sentences included.

There were other occasions where teachers expressed no concern and had no queries, but the committee members became aware when observing the annotations on the pages of the text, or the tester's comments on a child's response sheet, that the procedure for, or the purpose behind, a particular activity had been completely misunderstood. Analysis showed that the brevity of the wording was at fault, and the steps of the activity were rewritten in more detail so that they could be better understood.

Thus, although the Committee would prefer that the text be briefer that it is, it is not possible to arrange this without causing difficulties, ambiguities or misinterpretations. Teachers demanded that statements be full, exact, unambiguous and applicable to all eventualities. Ensuring this unfortunately involved expansion of the text rather than pruning into brevity.

* *That single-word numerical answers to narrative-type problems should not be accepted.* (It was said that these answers are "hardly acceptable here and certainly would not be in primary or secondary where lack of units means poor understandi g".)

It is recognised that older children working with more complex problems need to affix names to all their numerical answers and partial answers, in order to avoid errors in reasoning or interpretation. But it is felt that this requirement does not apply here.

The committee members believe that the normal, natural, everyday manner of answering a question such as "How many birds flew away?" would be with the number only e.g. "four". This, for young children, would not show lack of understanding, particularly if the answer were given without hesitation. The tester may, if desired, follow up the response by asking "four what?" to elicit the response "four birds". But the child should not be considered wrong if he does not automatically append the noun. After all, adults in normal conversation do not respond in this way, with nouns after every attribute. For example: "How many eggs will I buy?" "A dozen". (Not "a dozen eggs".)

Consider the following:
"What nationality was Murillo? "Spanish" (Not "Spanish nationality".)
"What colour cardigans do they wear at your son's school?" "Green". (Not "Green cardigans".)
"What church does he live near?" "Presbyterian". (Not "Presbyterian church".)

If the noun is not automatically attached to other attributes, why should we expect it to be attached to numerical attributes? Further, during the early stages confusion can be caused in some circumstances by this requirement, for instance when explaining the reasons for, or testing the understanding of, our notation system.

Consider this discussion about the numeral 5346. "How many hundreds?" "How many thousands?" The child may answer "three", or "three *hundreds*" (3 or 300) to the first question; these obviously do not signify the same amount. He may answer "five" or "five *thousands*" (5 or 5000) to the second question, which again are not the same amount. The child may be led to think there are 300 hundreds and 5000 thousands; it is obvious that misunder-

standings may arise unless the classroom responses are interpreted consistently.

The ability to convert a numerical answer into a sentence ("four" into "There are four birds" or "Four birds flew away") is one that *is necessary*, but does not come naturally to children; it will only be possible for them to do so after much training and practice. Such a skill is useful when giving written answers to problems, but will first need to be practised in oral form.

The type of answer which includes number and noun ("four birds"), when given without prompting by a young child, actually shows an intermediate stage between one-word answers and sentence answers. The child is not so much attaching a noun to his numerical response, as giving an incomplete sentence in which one part is "understood", for example, "(There were) four birds", or "Four birds (flew away)".

On these grounds the committee believes that the three types of answers are all natural, logical and permissible according to the stage of development of the child, and that none should be considered unacceptable.

* * * * * * * * * *

DOCUMENTS USED IN THE TRIALLING PROGRAMME

i. In preparation for the programme

The duplicated and bound form of the test procedures has been called the "trialling document" throughout these notes. In preparing for its trial use in schools, various printed notes giving information to teachers, or requiring information from teachers, were issued to schools. These printed notes and forms are the ones referred to as *documents* in this and the following section.

It is felt that a perusal of these may be of value to people interested in how these test procedures were trialled in the schools, or perhaps how similar projects may be prepared for trialling.

A. After the complete series of Objectives were listed and the relevant test procedures were compiled they were typed and duplicated on foolscap paper, then collated and stapled into book form (31cm x 24cm x 4.5cm approximately) ready for use by teachers in trialling. At the third term Conference of the North Sydney Infants' Mistresses' Council in 1977 at the time when the book was in the course of preparation, a report was given to the Mistresses present, and offers to take part in trialling were sought. A form was provided for sending back to the Committee after due consideration. A copy of this report, and the accompanying form is shown.

REPORT

MATHEMATICS EVALUATION PROCEDURES
TRIALLING

The Procedures and Test Items in Mathematics Evaluation for Number, Shape and Measurement (Length, Mass, Volume, Temperature, Area, Time and Money) have now been written.

The next stage is that of trialling.

For a broad assessment of the document a wide spectrum of school situations is required.
These will include:

- staffs on a whole school basis
- individual teachers in staffed schools (a) kindergarten teachers, (b) Year 1 teachers, (c) Year 2 teachers
- teachers in one-teacher schools
- teachers of lower primary classes

Before carrying out the trials,

- some teachers will be given the document for study without any prior discussion
- some teachers will take part in individual discussion about the document with mistress/principal
- some will participate in whole staff discussion sessions about the document

Trialling will involve the following conditions:

1. Test items are to be given, in the first instance, to children whose natural language is English. Later, if present in the school, appropriate children in the categories shown below may be tested, if desired.
   (a) Those with minimal understanding of English (original language, and not English, spoken at home)
   (b) Those with fair competency in English (original language, and not English, spoken at home).
   (c) Those with fair competency in English (both languages spoken at home).
   The category would be stated, in words, on the Child's Response Sheet. (Children with no understanding of English would not be subject to testing.)
2. Meetings and interviews with those participating may be held before and after the trialling.
3. The completion of questionnaires by class teachers and by mistress/principal will be required.
4. All documents, including Response Sheets of children tested, are to be returned by or on the date nominated.
5. The trialling will be carried out over a period of at least two terms, and reporting will be necessary during this period.
6. It is the intention that *a few children only* from each class will be tested; it is anticipated that approximately 5-8 tests per child may be required.

If you are prepared to have your school involved in this trialling, and to take part yourself, please fill in the attached form, and return it to Mrs. M. Muir, 26 Orchard Road, Beecroft 2119 on or before 1st November, 1977.

When these forms have been received, a selection of schools will be made, so that there will be a balanced sampling. You will be informed before the end of this term if your school has been selected, and of the category in which the trialling will be required (e.g. Number, Shape, Length).

N.S.R.I.M.C. Committee for
Mathematics Evaluation

N.S.R.I.M.C.
Mathematics Evaluation Committee

We would like to be involved in the Trialling of the Evaluation Document in 1978.

School ..... Department .....

Phone Number .....

Address .....

.....

..... Postcode .....

Mistress or Principal .....

Number of classes in dept .....

Approximate total enrolment of dept. in 1978 .....

R.S.V.P. by 1.11.77 Signed .....

to Mrs. M. Muir, Date .....
26 Orchard Road,
BEECROFT 2119.

B. When the offers of participation were received schools were placed in one of the categories and allotted one of the strands for testing. A list was made and duplicated using the following headings:

Category

School/ Dept.	Strand(s) to be trialled	Name of Principal or Mistress	Names of teachers to be involved (including year taught)	Signature of Principal or Mistress for receipt of documents.

A copy of these lists was supplied with every book so that all would know their relationship within the programme, and the particular strand with which they, and also their colleagues, were working.

Schools in Category I were:
Balmoral, Brisbania Infants, Carlingford Infants, Hornsby South Infants, Hunters Hill Infants.

Schools in Category II were:
Berowra Infants, Erina Heights Infants, Greenwich Infants, Kanwal Infants, Manly Infants, Manly West Infants, Ryde East Infants, Seaforth Infants, The Entrance Infants, Wideview Infants, Wyoming Infants, Mosman Infants, Wahroonga Infants.

Schools in Category III were:
Allambie Heights Infants, Avalon Primary, Avalon Infants, Balgowlah Heights Infants, Beecroft Infants, Hornsby North Primary, Bexley Infants, Gordon Primary, Hornsby Heights Infants, Lane Cove West Primary, Lindfield East Infants, Mona Vale Infants, Mosman Primary, Pennant Hills Infants, Pennant Hills West Infants, St. Ives Infants, St. Ives Primary, Thornleigh West Infants, Toukley Infants.

Schools in Category IV were:
One two-teacher school and five one-teacher schools in the Bathurst area.

List of Participating Schools (Sample page)

CATEGORY I (continued)

School - department	Strand(s) to be trialled	Principal or Mistress	Names of teachers involved (including Year taught) PLEASE PRINT.	Receipt: Principal or Mistress to sign.
Carlingford Infants	Area	Mrs. Joan Graham	1. Mrs. Joan Graham 2. ..... 3. ..... 4. ..... 5.	Received 5 copies Signed .....
Hornsby South Infants	Length	Mrs. M. Hartnett	1. Mrs. M. Hartnett 2. ..... 3. ..... 4. ..... 5. ..... 6.	Received 6 copies Signed .....
Hunter's Hill Infants	Number	Mrs. M. Nettleship	1. Mrs. M. Nettleship 2. ..... 3. ..... 4. ..... 5.	Received 5 copies Signed .....

ii. During the Trialling period

In adcition to the list of participating schools and the typewritten, duplicated, foolscap-sized, staple-bound, 4.5cm thick Document containing the test procedures and notes for their administration, teachers were given various letters, and forms to fill in and return. Copies of these letters and forms included here are for your interest and to indicate the type and extent of the trialling, and feedback to the committee.

A. When the list of offers to participate in the trialling programme had been compiled following the 3rd Term Conference of the N.S.R.I.M.C. in 1977 the following letter was sent to Mistresses and Principals.

B. A letter was sent to every teacher in Category III and Category IV who was to carry out testing without guidance from the Principal, mistress or other teachers in the school. A copy is shown below.

Mathematics Evaluation Committee

29th November, 1977

Dear .....

Thank you for offering to take part in the trialling of the Mathematics Evaluation Procedures.

Your school/department has been selected to participate in these trials, and ..... teachers will be involved. The category in which your school/department has been placed is .....

An In service course has been arranged for the Mistress or Principal of the school or department involved.
This will be held on 1st March, 1978, 9.30 - 3.30 at **Naremburn Professional Teachers' Centre**.

It is imperative that those whose teachers are involved should attend this course.

The course titled, "Mathematics Evaluation Procedures" will be advertised in the Inservice Booklet for 1978. It will be necessary for you **to make application** to attend this course, in the usual way on the usual inservice forms.

Copies of the trialling document will be distributed at the course and implementation procedures will be outlined.

Thank you for your help.

Yours sincerely,

.....
M. Muir,
For the Mathematics Evaluation Committee
(E. Callan, M. Muir, K. Yabsley).

N.S.R.I.M.C.
Mathematics Committee,
C/- Infants' Department,
Public School,
Wahroonga. 2076.

1st March, 1978.

Dear Trialler,

Thank you for being willing to carry out these tests for us. Our main purpose in trialling the procedures in this Document is to test their validity under a variety of different conditions.

This is why some of you will be given familiarization sessions before starting the trials, and others will be working without any explanations other than those given in the document itself. Triallers have been allotted to four different categories.

An Inservice Course (Mathematics Evaluation Procedures NS78/90) will be held on 17th April, 1978 for those in Categories I and II. Two trialling representatives (other than the Infants Mistress) from Category I schools, and the trialling teachers, years 1 and 2, from Category II schools are expected to make application to attend this course. The closing date is 28th March, 1978. (Kindergarten teachers will not commence their trialling until later in the year.)

Triallers in Categories III and IV will not receive these explanations and will work from the document alone.

We hope thus to obtain a wide range of comments and reactions, so that in the light of these we will be able to amend and refine the document. Your contribution will therefore be of great importance to us, and will help us in getting the document in its final form.

We want you to write any suggestions, comments, opinions and findings that you may have to offer on the blank page facing the relevant Procedure as printed.

You will be required to return to the Committee the document with your annotations, together with the completed Response sheets you have made and used with the children you have tested, and your answers to a Questionnaire about your findings, which you will receive later.

Again, thank you for your help,

Yours sincerely,

.....
K.B. Yabsley
for the Mathematics Evaluation
Committee of the N.S.R.I.M.C.

C. It was necessary to provide some guidance to Principals and Mistresses as to what to *say* to teachers who were to trial the tests without help or discussion within the school. A sheet was provided for each Principal or Mistress setting out what to say when the Trial Document was handed to the participating teacher.

MATHEMATICS EVALUATION PROCEDURES K - 2

Instructions to be given to trialling teachers in Categories III and IV.

Category III — oral instructions to be given to teacher by Principal or Mistress.

Category IV — instructions will be given to teachers-in-charge by means of a letter from Dr. Perry.

"We have agreed to carry out trialling in Mathematics Evaluation Procedures.

Here is the document, there is a letter for you inside.

You will be working in the strand of ..... (number, area, etc).

Read the Introductory pages i to xxiii.

Use the index to find the objectives in your strand. Read and study them.

Select about three children in your class or group who:

(1) are experiencing difficulty in the given strand

or

(2) are newcomers whose level of achievement or understanding (in this strand) you wish to ascertain.

Follow carefully the test procedures set out for the strand.

Record the child's responses on a Response Sheet drawn up by yourself (Sample in document). Write your "diagnosis" after testing, on each child's Response Sheet.

As you work from the document, write any comments on the facing pages, as suggested on page xvii.

Later a questionnaire will be sent to you for further comments.

Thank you for your help."

D. Children's Response Sheets, completed after testing, were sent in from each participating teacher. Child and teacher were both anonymous to the committee, but in order for assessment to be complete it was necessary to know certain information about both. The Identification Form shown was sent to schools for this purpose.

IDENTIFICATION FORM

Identification of school, class and teacher.

Please attach an Identification Form to *each* completed *Child's Record Sheet* before returning to the ... Committee.

CHILD'S NAME (first name or initials) .....

Name of school .....

Classification of Dept /School .....

Grade Placement of child tested .....

Type of class in which child is placed .....

(parallel, streamed, other; any further details?) .....

.....

Was tester child's teacher? .....

If not, who was tester? .....

Length of service of tester .....

Date .....

E. The Questionnaire was sent to teachers in the various categories to be returned on different selected dates. After each batch was returned the Committee met to consider the replies so that progressive revision of the Document could take place. A copy of the questionnaire sent out for return on 16th October, 1978 is shown. Only the date varied on the other sets of questionnaires.

Please return by 16th October, 1978 to the address below all the following:

(1) This questionnaire,

(2) The document "Mathematics Evaluation Procedures K-2" with your comments and annotations,

(3) All the completed Response Sheets (including your diagnosis and suggested follow-up) for the children you have tested. Please *staple* an Identification from to each Response Sheet.

Return to:

Mrs. M. Muir,
26 Orchard Road,
Beecroft.
2119.

Note: A number of Identification Forms has been supplied. If this is insufficient please duplicate sufficient extra copies so that one can be attached to each Response Sheet.

MANY THANKS

NORTH SYDNEY REGION INFANTS MISTRESSES COUNCIL
MATHEMATICS EVALUATION K-2
TRIALLING PROCEDURES
QUESTIONNAIRE

SCHOOL ..... Date .....
CLASS (IF ANY) TAUGHT BY TESTER .....
NUMBER OF CHILDREN TESTED (state class or grade of each) .....
First Names .....

LENGTH OF SERVICE OF TESTER ..... YEARS
QUESTIONNAIRE FILLED IN BY MISTRESS/PRINCIPAL/CLASS TEACHER
(State which) .....
Name not required

All questions should be answered by the tester, except questions 20 and 21, which are to be answered by the mistress or principal.

Note If there is insufficient space to write any answer fully, please attach a separate sheet for continuation. (State the number of the question being answered.) Do *not* write on the back of any questionnaire sheets.

INTERPRETATION OF TEST

1 What was your reaction to the whole document on first reading?

Why?

2 Did your opinion change later?
If so why?

3 (a) Were the explanations clear in the introductory statements concerning rationale?
Comment

(b) Were the explanations clear in the introductory statements concerning recording?
Comment

4 (a) Were you able to understand the purpose of the test items from the objectives stated?
Comment

(b) Were you able to understand the language used in the instructions for the test procedures?
Comment

(c) Were you able to understand the statements used in setting out the Acceptable Responses from the child?
Comment

5 Did you need to adapt the wording in the test items to suit individual children, or to clarify their responses to the test questions?
(If so, please record your adaptations on the page facing the relevant test item in the document.)
Comment here also

6 Did you find the format of the suggested Child's Response Sheet easy to follow?
Comment

7 Did you find it difficult to record the Objectives briefly on the Child's Response Sheet by using "Key Words"?
Comment

8 Did you find the marking code adequate?
Comment

9. Have you any other comments concerning the interpretation of the whole document, or parts of it?

ADMINISTRATION OF TESTS

10. Before beginning testing, what familiarization procedures were adopted? (Independent reading of document? Individual discussion with mistress/principal? Whole staff involvement? Other?) Please describe the familiarization procedures used

11. What classroom organization was required for administering the tests? (i) Where given? (ii) What happened to rest of class? (iii) Who was tested? (iv) Other details?

12. How were children selected for diagnostic testing? (Low marks? Constant failure? Lack of progress? New pupil? Other?)

13. Were normal and bright children tested in order to gain familiarity with the test procedures?

Was this beneficial? Comment

14. How long did you spend with each child before arriving at a diagnosis?

Comment

15. How many Objectives in each case had to be tested before arriving at a diagnosis?

Comment

16. How did you select the Objective to find the starting point to test a child?

How successful do you feel your method of selection was?

Comment

17. Was there an Objective in which a number of the children continually failed?

(Note this also in the Document on the page facing the relevant test items.) Can you suggest a reason for this common failure? (Not taught? Difficult concept? Poor test items? Other?)

18. Were the test materials suggested readily available or easily made, and suitable for the purpose?

Comment

19. Have you any other comments concerning the administration of the tests?

If so, state here

20. (Mistress/principal to answer) When you re-tested a child previously tested (in order to ascertain reliability of test procedures) were your results the same?

Please give details

21. (Mistress/principal to answer) Would the results of this test be useful to you in school organization? (e.g. class placements? Disciplinary policies? Work of resource teacher? Purchase of equipment? Other? What limitations can you see in the use of this test?

Comment

GENERAL

22. Do you consider that test series such as this are necessary?

Useful? Comment

23. Did you find the knowledge gained from the testing valuable to you in terms of

(a) your understanding of the child?

Comment

(b) advantages or benefits for the child?

Comment

(c) Planning of future teaching/learning programmes?

Comment

24. This series of tests is based on evaluating of stated objectives. Do you feel "comfortable" with this approach?

Comment

25. After arriving at a diagnosis from study of a child's Response Sheet, were you able to arrive at a conclusion about the child's level of achievement, or his difficulties?

Comment

26. Were you able to make a decision in each case about the kind of follow-up work required? (Teach? Re-teach? Plan other activities? Give more experience in a particular aspect? Allow child further time in same grade? Other?)

Comment on difficulty of decision

Note: Write suggested follow-up procedures on the back of the Response Sheet of each child tested following the statement of your diagnosis. (These sheets are to be returned with this questionnaire.)

To remove cut along perforation lines

Sheet No. ☐

CHILD'S RESPONSE SHEET

Code:
- ✓ acceptable response
- X failed
- • item not presented (futile)
- – item not presented (unnecessary)
- ▨ further items not possible

Name: _____ d.o.b. _____ Class: _____ Date: _____

Objective No.	Objective Keywords	Procedure No.	Responses to test items										Success or failure	Comments on performance (if required)
			1	2	3	4	5	6	7	8	9	10		

Suggested Response Sheet for schools to duplicate
(may be adapted to foolscap size)

Diagnosis:

Follow up:

To remain in book for permanent reference.

Child's page No. ☐

Record Sheet of Child's Responses

Name: _____

class: _____ d.o.b. _____

date: _____

Marking code

acceptable response	✓
failed	X
item not presented (futile)	•
item not presented (unnecessary)	–
further items not possible	▨

Objective No.	Keywords	Procedure No.	Responses to test items 1	2	3	4	5	6	7	8	9	10	Success or failure	Comments (if required)

Suggested Response Sheet for schools to duplicate (may be adapted to foolscap size)

Diagnosis:

Follow up: